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DEPARTMENT OF THE INTERIOR
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UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

MINERAL RESOURCES

OF THE

UNITED STATES

1921

G. F. LOUGHLIN
Geologist in Charge, Division of Mineral Resources

PART I—METALS

G. F. LOUGHLIN, Geologist in Charge

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MINERAL RESOURCES OF THE UNITED STATES, 1921—PART I.

MINERAL RESOURCES OF THE UNITED STATES.[1]

INTRODUCTION.

By G. F. Loughlin, Geologist in charge, Division of Mineral Resources.

The general industrial depression that began in the fall of 1920 continued throughout 1921, although improvement in some industries began late in the year. This improvement has become more marked during the first five months of 1922, but industry as a whole still lacks stability, and at the time of writing (May, 1922) is affected by the most widespread coal strike in the country's history. The general foresight, especially of industrual consumers, in accumulating stocks of coal to tide over the strike period has thus far prevented a shortage of coal, and general indications are that business will not be seriously retarded but that the results of the strike will tend to hasten the attainment of industrial stability.

During 1921 continued high wages and other operating costs and high freight rates were strong factors in preventing the lowering of prices of some commodities to levels that would attract buyers and still allow producers a profit. Buyers would not contract very far ahead, and producers, confronted by low prices and holding large stocks, preferred to wait rather than sell at a loss or to increase stocks further. Late in the year reductions in taxes and wages, with consequent lowering of operating costs and freight rates, together with the gradual depletion of stocks, encouraged a resumption of activity in some industries, but further adjustments are awaited before a close approach to normal conditions can be attained.

The total value of the mineral products of the United States in 1921 was about $4,139,000,000, a decrease of more than 40 per cent from the record value of 1920 ($6,981,340,000). This decrease was due not only to the lessened production but to the lower unit value for most minerals.

The depressed and unsettled conditions in 1921 are reflected by the greatly decreased output of bituminous coal, which dropped back to the level of 1910 and 1911. The output of by-product coke was the smallest since 1916, and that of beehive coke the smallest since 1885. Only anthracite, of the solid fuels, had an output that compared favorably with that of 1920. Comparisons of quantity alone, how-

[1] All figures of imports and exports in this report were compiled by J. A. Dorsey, of the Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, Department of Commerce, having been converted by Mr. Dorsey to the various units of measurement used in this report and arranged by him in their present form. The imports are those for the calendar year unless otherwise stated. Wherever exports are shown, unless otherwise specified, the figures represent domestic products and not foreign minerals reexported, and they also cover calendar years.

ever, fail to reveal the true magnitude of the depression in the bituminous-coal industry. In terms of working-days lost through lack of demand, 1921 exceeded even the years that followed the panic of 1893. The average number of days worked was 149 out of a possible working year of 308 days. Union mines suffered most in this respect, as nonunion mines operated on a reduced wage scale and invaded markets hitherto held by union producers.

The production of soft coal began to decline late in December, 1920. The market broke, and prices decreased steadily. A temporary recovery in May and June registered an export demand caused by the British miners' strike. Another spurt of buying occurred in October, when consumers were laying in reserves against a possible strike of the railroad workers. This strike did not take place, and the reaction against the enforced activity of October was especially severe.

Little net change in the quantity of coal in storage occurred during the year. On January 1, 1921, consumers' stocks were about 46,000,000 tons. A steady decline during the first half of the year was offset by a rapid accumulation of stocks in anticipation of the railroad workers' strike, and by December 31 stocks amounted to 48,000,000 tons, or 41 days' supply at the rate of consumption then prevailing. The expected miners' strike, which began April 1, 1922, caused far-sighted consumers to increase their stocks still more during the first quarter of the new year.

In sharp contrast to the bituminous-coal industry, the anthracite mines continued steadily at work through most of 1921. The total output of freshly mined coal, from which the requirements of householders are met, exceeded that of 1920. The surplus in excess of current requirements was stored by the producers. Not until late in November did the cumulative effect of the industrial depression and a mild winter force a lessening of activity in the anthracite region.

The outstanding feature of the coke industry in 1921 was the further substitution of by-product coke for beehive coke. By-product coke contributed 78 per cent of the total production, compared with 60 per cent in 1920. The slump in demand for coke and by-products, however, discouraged further developments, and the number of by-product ovens under construction at the end of the year was only 85, the smallest since 1899.

In contrast to coal, petroleum continued to increase in output and established a new record in 1921, more than double the output in 1912. Imports also increased, establishing a new record, and amounted to 27 per cent of the domestic production, compared with 24 per cent in 1920 and 14 per cent in 1919. Exports increased slightly but were relatively small. Consumption decreased, however, particularly during the first half of the year, and in May was even less than domestic production; but a partial recovery followed, and the estimated consumption for the year exceeded the domestic production by 53,849,000 barrels. Stocks consequently increased and at the end of 1921 were equivalent to 132 days' supply at the current rate of consumption, compared with 88 days' supply at the end of 1920. The year opened with record prices that had prevailed for several months in spite of the rapid increase of stocks. Prices soon began to fall, however, and within a few months Pennsylvania grade had declined from $6.10 to $2.25 a barrel, and Oklahoma-Kansas

grade from $3 to $1. These low prices held until September, when the rate of increase of stocks lessened somewhat, and the year closed with Pennsylvania grade at $4 and Oklahoma-Kansas grade at $2. Low prices were reflected in a marked curtailment of field activity, and only five-eighths as many producing wells were reported to have been completed in 1921 as in 1920. Nevertheless a number of new pools were opened, among which were Haynesville, La., Eldorado, Ark., Burbank, Okla., and Pierce Junction and Mexia, Tex., and extensive new developments were made in the Elk Hills and at Huntington Beach, Calif. California's record output would have been even greater had it not been for a labor strike. Oklahoma also established a new record, maintaining its premier position, but its lead over California was materially reduced. Texas also produced more than 100,000,000 barrels and in December, as a result of developments at Mexia, ranked first among the producing States.

The year 1922 began with production, imports, and stocks of petroleum the greatest on record and with consumption not much below its peak but yet insufficient to prevent a continuous addition to stocks. This increase in supply may be counteracted during the year by a decline in imports from Mexico, whose production, which now comes chiefly from one zone, is expected by several well-informed geologists to decline rapidly in the near future.

The metal-mining industry, which was far below normal in 1919 and 1920, underwent a further decline in 1921. Copper was most severely affected. Producers, who had prematurely hoped for a brisk export as well as domestic trade and had continued production through 1920 only to increase the already excessive stocks, nearly all suspended operations by April 1, 1921, and the mine and smelter outputs for the year were the lowest since 1897. The refinery output was less than it has been at any time since electrolytic refining became the dominant process. The copper withdrawn on domestic account was 60 per cent of that withdrawn in 1920, and stocks at the end of 1921 were still large. Both domestic and foreign sales, however, increased late in 1921, and during the first four months of 1922 the largest mines resumed operations at greatly reduced capacity. At present the stocks on hand, exclusive of those held for export, are generally believed to be insufficient to supply the domestic withdrawals longer than until July or August, and the recent advance in the price of copper in all probability is due entirely to the depletion of stocks. By July, however, the product of the mines that were reopened in the spring of 1922 should reach the market, and after that the price of copper will probably not advance materially if at all. Under the present conditions it is extremely unlikely that consumption can equal the capacity for production, hence only the operators who have large reserves of high-grade ore, low costs, or special outlets for their product may hope for reasonable profit.

Zinc also showed a great decrease in output (nearly 60 per cent) in 1921, and the consumption was less than two-thirds of that in 1920. The demand for it was so poor that four of the Western States—Arizona, Idaho, Nevada, and Utah—made few shipments in 1921, and Montana's output was only one-eighth of its output in 1920. During the first half of 1921 the low rates of exchange permitted the importation of a large quantity of sheet zinc, but in the

second half the price of American sheet zinc dropped below that of the foreign product.

The decrease in production of lead in 1921 was much less than in that of copper or zinc, on account of the high silver content of some of the ore, but the demand for lead itself was very poor. Consumption was nearly 20 per cent less than in 1920 but exceeded that of 1919. Heavy imports, which began in 1920, owing to the rates of foreign exchange, continued into 1921.

Production and shipment of iron ore, pig iron, and steel decreased in proportion to those of copper and zinc and there were corresponding decreases in the demand for ferroalloys, fluxes, and refractories. The output of iron ore was the lowest since 1904. Conditions improved in the last half and especially in the last quarter of 1921. In addition to the lack of demand, the accessory metals for steel, particularly manganese, chromium, and tungsten, were adversely affected by imports of high-grade ore or by large stocks sufficient to supply manufacturers for a considerable time. The output of other minor metals showed large decreases, the mining of some ceasing entirely.

Gold and silver did not fare so badly, but the total output of each was somewhat lower than in 1920 on account of the reduced output of copper and lead ores from which large quantities of gold and silver are recovered as subordinate products. Although the total production of gold decreased, increases were recorded from four States—California, Idaho, South Dakota, and Washington—where dry and siliceous ores are the principal sources. The mining of these ores, already reduced to a minimum, was encouraged as soon as costs began to decline, and during the last half of the year there was pronounced activity, especially in the Mother Lode region of California and the Black Hills of South Dakota. The high price of silver, maintained by the Pittman Act, together with lower costs of mining, accounted for increases in the production of silver from dry and siliceous ores in California, Colorado, and Utah. Smelter restrictions in Utah and a strike in Tonopah, Nev., prevented increase in total production of silver in those States. Further reductions of mining costs and of freight rates on bullion, effective in January, 1922, together with the reopening of the larger copper and lead mines, give a very encouraging outlook for 1922.

Foreign silver, unprotected by legislation, declined rapidly in price early in the year, reaching a minimum of less than 57 cents an ounce in March, then rose irregularly to about 71 cents in October, and again declined to 65 cents at the end of the year. These fluctuations are attributed to changes in demand in India and China and emphasize the temporary advantage given to domestic silver mining by the Pittman Act. The total silver purchased under this act up to June 30, 1922, was 117,362,506 fine ounces. The remainder authorized by the act, 90,637,494 ounces, will at the expected rate of mining be purchased by the end of 1923.

The dull state of the chemical industries in 1921 is reflected generally by the greatly reduced shipments of sulphur and pyrites and of chemical lime and limestone, and more specifically by reduced shipments of the other minerals that enter the chemical industries in considerable quantity. The production and shipments of agricultural minerals also declined greatly, as the decreased prices of

farm products and high freight rates prevented farmers from purchasing mineral fertilizers, and low rates of exchange discouraged exporters. Sales of phosphate rock declined 50 per cent, and sales of potash were less than in any other year since 1915. Domestic potash was affected not only by the dull market but by the low price of foreign potash. Improvements in methods of production, however, and the recent discovery of potash deposits in Texas that may prove of commercial importance afford hope that the United States may yet attain independence in the potash industry.

The sale of materials for construction in 1921 decreased less as a whole than those of the other groups. Shipments of Portland cement decreased less than 1 per cent and lime and gypsum for construction work 5 and 6 per cent respectively.

On the other hand, sales of stone paving blocks increased about 16 per cent and building and crushed stone about 7 per cent in quantity. Resumption of construction after the general curtailment of recent years created a strong demand, which was counteracted by high costs of fuel and equipment, high freight rates, and in some places by labor difficulties. Improvement of municipal, suburban, and country roads, however, was less affected than private construction. Conditions improved late in 1921, and progress in the first quarter of 1922 points to considerable increase in the sales of all building materials.

Statistics in this report relating to production of clay products, sulphuric acid from copper and zinc smelters, sand-lime brick, and silica brick were obtained by the Bureau of the Census, which took over the canvass of these industries formerly conducted by the Geological Survey.

SUMMARY.

By Martha B. Clark.

GENERAL TABLES.

Mineral products of the United States in 1920 and 1921.[a]

Product.	1920		1921		Percentage of increase or decrease.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
METALLIC.						
Aluminum.....pounds..	.....	$41,375,000	.....	$10,906,000	.....	−74
Antimonial lead[b].....short tons (2,000 pounds)..	12,335	1,963,255	10,064	870,059	−20	−56
Antimony[c].....do....	2,785	c 473,450	1,589	c 157,629	−43	−67
Bauxite.....long tons (2,240 pounds)..	521,308	3,247,345	139,550	889,800	−73	−73
Cadmium.....pounds..	129,283	151,261	65,101	63,799	−50	−58
Chromite.....long tons..	2,502	44,857	282	2,900	−89	−94
Copper[d], sales value.....pounds..	1,209,061,040	222,467,000	505,586,098	65,221,000	−58	−71
Ferroalloys.....long tons..	612,808	77,519,367	248,627	21,697,785	−59	−72
Gold[e].....troy ounces..	2,476,166	51,186,900	2,422,006	50,067,300	−2	−2
Iron:						
Ore[f].....long tons..	69,281,341	f 285,006,327	26,652,528	f 89,745,308	−62	−69
Pig.....do....	35,710,227	1,140,904,096	16,038,619	389,437,792	−55	−66
Lead (refined),[d] sales value.....short tons..	476,849	76,296,000	398,222	35,840,000	−16	−53
Manganese ore (35 per cent or more Mn).....long tons..	94,420	2,396,235	13,531	495,097	−86	−79
Manganiferous ore (5 to 35 per cent Mn)[g].....do....	767,664	2,437,798	97,099	255,131	−87	−90
Nickel (value at New York City).....short tons..	365	293,250	111	86,000	−70	−71
Ores (crude):						
Copper.....do....	36,765,000	(h)	13,369,000	(h)	−64	.....
Copper-lead and copper-lead-zinc.....do....	27,000	(h)	14,000	(h)	−48	.....
Dry and siliceous (gold and silver).....do....	8,590,000	(h)	8,418,000	(h)	−2	.....
Lead.....do....	7,200,000	(h)	7,129,000	(h)	−1	.....
Lead-zinc.....do....	12,383,000	(h)	3,736,000	(h)	−70	.....
Zinc.....do....	2,651,000	(h)	1,708,000	(h)	−36	.....
Platinum and allied metals (value at New York City).....troy ounces..	41,544	4,697,722	56,370	4,238,989	+36	−10
Quicksilver (value at San Francisco).....flasks (75 pounds net)..	13,392	1,056,807	6,339	300,595	−53	−72
Quicksilver ore.....short tons..	109,000	(h)	35,000	(h)	−68	.....
Silver.....troy ounces..	55,361,573	60,801,955	53,052,441	53,052,441	−4	−13

Tin (metallic equivalent)	short tons	22	22,000	4	2,400	−82	−89
Titanium ore (rutile)	do	277	(*i*)			−100	−100
Tungsten ore (60 per cent concentrates)	do	216	101,800			−100	−100
Uranium and vanadium ores	do	35,076	2,401,000	8,540	876,000	−76	−64
Zinc,[d] sales value	do	450,045	72,997,000	198,232	19,823,000	−56	−73
Total value of metallic products (approximate)			1,762,350,000		654,130,000		−63
NONMETALLIC.							
Arsenious oxide	short tons	11,502	2,021,356	4,786	717,700	−58	−64
Asbestos	do	1,648	*j* 678,231	831	336,968	−50	−50
Asphalt	do	898,993	13,199,365	920,632	11,033,804	+2	−16
Barytes (crude)	do	228,113	2,142,464	66,369	531,958	−71	−75
Borates	do	120,320	2,173,000	50,000	1,600,000	−58	−26
Bromine	pounds	1,160,584	745,381	711,953	172,759	−39	−77
Calcium-magnesium chloride	short tons	27,849	539,471	23,672	510,723	−15	−5
Cement	barrels (376 pounds net)	97,079,200	195,589,915	96,046,549	181,675,440	−1	−7
Clay:							
Products			373,670,102		*k* 270,397,754		−28
Raw *l*	short tons	3,116,212	*f* 11,614,288	1,716,716	*f* 6,025,300	−45	−48
Coal:							
Bituminous *l*	do	*j* 568,666,683	*j* 2,129,933,000	415,921,950	1,199,983,600	−27	−44
Pennsylvania anthracite	long tons	79,998,437	434,252,198	80,779,867	452,304,903	+1	+4
Coke *l*	short tons	51,345,043	*f* 494,246,254	25,287,622	*f* 147,673,095	−51	−70
Diatomaceous (infusorial) earth and tripoli	do	102,155	1,649,370	67,474	895,629	−34	−46
Emery	do	2,327	21,685	305	2,250	−87	−90
Feldspar (crude)	long tons	135,551	851,123	91,865	617,652	−32	−27
Fluorspar	short tons	186,778	4,718,547	34,960	724,094	−81	−85
Fuller's earth	do	128,387	2,506,189	105,609	1,973,848	−18	−21
Garnet for abrasive purposes	do	5,476	434,425	3,048	260,687	−44	−40
Gems and precious stones			265,205		518,280		+95
Graphite:							
Amorphous	short tons	4,694	49,758	1,842	20,860	−61	−58
Crystalline	pounds	9,632,360	576,444	1,189,523	75,664	−88	−87
Grindstones and pulpstones	short tons	53,484	1,707,004	26,340	1,227,322	−51	−28
Gypsum	do	3,129,142	24,533,065	2,890,784	23,700,290	−8	−3
Lime	do	3,570,141	37,543,840	2,532,153	24,895,370	−29	−34

a In this general statement certain of the figures represent shipments rather than quantity mined. The reader is referred to the following sections on the various mineral products for information in greater detail than it seems practicable to give here.

b From both domestic and foreign ores.

c From all sources. Values excluded from metallic totals as the values of the antimony contained in antimonial lead are included in the antimonial lead values, and the remainder under last item ("Unspecified").

d Product from domestic ores only.

e Value, $20.671834625323 an ounce.

f Value not included in total value.

g Including ore used for fluxing. For separation see p. 66A.

h Figures showing values not available.

i Value included in total value of metallic products. Survey not at liberty to publish figures.

j Revised figures.

k Canvass discontinued by Geological Survey after 1920. Figures for 1921 obtained through cooperation with Bureau of the Census.

l Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.

Mineral products of the United States in 1920 and 1921—Continued.

Product.	1920		1921		Percentage of increase or decrease.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
NONMETALLIC—continued.						
Magnesite (crude)...short tons	303,767	$2,748,150	47,904	$510,177	−84	−81
Mica:						
Scrap...do	5,723	167,017	2,577	56,849	−55	−66
Sheet...pounds	1,683,480	546,972	741,845	118,513	−56	−78
Millstones	.....	63,325	.....	24,524	.....	−61
Mineral paints:						
Natural pigments [a]...short tons	(a)	(a)	(a)	(a)	(a)	(a)
Zinc and lead pigments [b]...do	143,244	24,564,572	102,463	14,801,032	−28	−40
Mineral waters...gallons sold	36,218,260	4,860,915	34,781,238	4,876,445	−4	+.3
Natural gas...M cubic feet	798,210,000	196,194,000	662,052,000	174,617,000	−17	−11
Natural-gas gasoline...gallons	384,743,922	71,788,122	449,934,402	61,815,258	+17	−14
Oilstones, etc...short tons	1,144	231,747	831	173,025	−27	−25
Peat...do	73,204	921,732	30,406	260,119	−58	−72
Petroleum...barrels (42 gallons)	442,929,000	1,360,745,000	472,183,000	814,745,000	+7	−40
Phosphate rock...long tons	4,103,982	25,079,572	2,064,025	12,270,070	−50	−51
Potash (K_2O)...short tons	41,444	7,463,026	4,408	447,859	−89	−94
Pumice...do	41,838	114,433	37,108	158,540	−11	+39
Pyrites...long tons	310,777	1,596,961	157,118	711,432	−49	−55
Salt...short tons	6,840,029	29,894,075	4,981,154	24,557,966	−27	−18
Sand:						
Glass...do	2,165,926	4,748,690	1,280,359	2,314,314	−41	−51
Molding, building, etc., and gravel...do	79,875,462	60,912,915	78,564,649	54,268,310	−2	−11
Sand-lime brick...thousands	169,761	2,490,283	[c] 93,105	[c] 1,216,077	−45	−51
Silica (quartz)...short tons	68,190	320,350	11,252	84,957	−83	−73
Slate...do	468,700	8,726,442	411,500	7,322,006	−12	−16
Stone...do	78,527,000	133,541,960	63,538,740	106,962,266	−19	−20
Sulphur...long tons	1,517,625	30,000,000	954,344	17,000,000	−37	−43
Sulphur acid (60° Baumé) from copper and zinc smelters...short tons	[d] 1,229,508	13,617,075	[e] 621,026	[e] 6,576,500	−49	−52
Talc and soapstone...do	210,635	3,035,449	126,434	1,821,451	−40	−40
Thorium minerals (monazite)...pounds	(f)	(f)	(f)	(f)	.....	.....
Total value of nonmetallic products (approximate)	.....	5,214,170,000	.....	3,481,890,000	.....	−33

SUMMARY.

Total value of metallic products		1,762,350,000		654,130,000		−63
Total value of nonmetallic products (exclusive of mineral fuels)		1,021,260,000		778,420,000		−24
Total value of mineral fuels		4,192,919,000		2,703,470,000		−36
Total value of "unspecified" (metallic and nonmetallic) products (partly estimated)[g]		4,820,000		[g] 2,650,000		−45
Grand total approximate value of all mineral products		6,981,340,000		4,138,670,000		−41

[a] Canvass discontinued after 1915. Value of iron ore sold for paint included under last item ("Unspecified").
[b] Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.
[c] According to Bureau of the Census.
[d] Includes 23,728 tons of stronger acid, not converted to 60° Baumé.
[e] Canvass discontinued by Geological Survey after 1920. Figures for 1921 obtained through cooperation with Bureau of the Census and represent production, the value having been partly estimated by the Survey to cover acid consumed by producer as well as that sold.
[f] No information available for publication.
[g] Includes in 1921 the value of the following products: Bismuth ($396,000), cadmium sulphide ($71,336), chats ($260,000), columbite ($1,150), flint lining for tube mills, iron ore sold for paint ($56,824), lithium minerals ($33,508), marls ($205,943), oil shale ($40), pebbles for grinding ($10,503), selenium ($89,148), shale oil ($1,000), silica sand and sandstone, finely ground ($802,450), sodium salts (sodium carbonate, sodium bicarbonate, sodium sulphate, and trona) from natural sources ($610,000), tellurium, and an estimate of the value of miscellaneous mineral products, statistics for which are not collected annually by the Survey.

Total value of mineral products of the United States from 1880 to 1921.

Year.	Metallic.		Nonmetallic.		Unspecified (metallic and nonmetallic).	Total.	
	Value.	Percentage of increase or decrease.	Value.	Percentage of increase or decrease.		Value.	Percentage of increase or decrease.
1880–1910[a]	$12,170,356,000	.....	$16,475,234,000	.....	$54,890,000	$28,700,480,000	.....
1911	680,907,000	−9	1,242,942,000	+0.4	232,000	1,924,081,000	−3
1912	862,008,000	+27	1,375,420,000	+11	366,000	2,237,794,000	+16
1913	878,869,000	+2	1,554,298,000	+13	378,000	2,433,545,000	+9
1914	686,639,000	−22	1,424,063,000	−8	470,000	2,111,172,000	−13
1915	991,730,000	+44	1,400,484,000	−2	2,430,000	2,394,644,000	+13
1916	1,620,745,000	+63	1,884,413,000	+35	3,281,000	3,508,439,000	+47
1917	2,086,234,000	+29	2,900,462,000	+54	5,800,000	4,992,496,000	+42
1918	2,153,318,000	+3	3,380,690,000	+17	6,700,000	5,540,708,000	+11
1919	1,359,744,000	−37	3,232,626,000	−4	3,400,000	4,595,770,000	−17
1920	1,762,350,000	+30	5,214,170,000	+61	4,820,000	6,981,340,000	+52
1921	654,130,000	−63	3,481,890,000	−33	2,650,000	4,138,670,000	−41
Grand total	25,907,030,000	.....	43,566,692,000	.....	85,417,000	69,559,139,000	.....

[a] For totals by years prior to 1911 see Mineral Resources, 1920.

Mineral products of the United States and leading producing States in 1921.

Mineral.	Principal producing States in order of value.
Aluminum	New York, North Carolina, Tennessee.
Antimonial lead	Not separable by States.
Arsenious oxide	Not separable by States.
Asbestos	Arizona, Maryland, Georgia, California.
Asphalt	California, Texas, Oklahoma, Illinois.
Barytes (crude)	Missouri, Georgia, Tennessee, Alabama.
Bauxite	Arkansas, Georgia, Alabama, Tennessee.
Borates	California, Nevada.
Bromine	Michigan, West Virginia.
Cadmium	Not separable by States.
Calcium-magnesium chloride	Michigan, West Virginia, Ohio, California.
Cement	Pennsylvania, Indiana, California, Michigan.
Chromite	Oregon, California.
Clay:	
Products	Ohio, Pennsylvania, New Jersey, Illinois.
Raw	New Jersey, Missouri, Pennsylvania, Georgia.
Coal:	
Bituminous	Pennsylvania, West Virginia, Illinois, Kentucky
Pennsylvania anthracite	Pennsylvania.
Coke	Pennsylvania, Indiana, Ohio, Alabama.
Copper	Arizona, Michigan, Alaska, Montana.
Diatomaceous (infusorial) earth and tripoli	California, Illinois, Oklahoma, Missouri.
Emery	New York, Virginia.
Feldspar (crude)	North Carolina, Maine, New York, Connecticut
Ferroalloys	Pennsylvania, New York, Alabama, Illinois.
Fluorspar	Illinois, Kentucky, New Mexico, Colorado.
Fuller's earth	Florida, Georgia, Texas, Arkansas.
Garnet for abrasive purposes	New York, New Hampshire.
Gems and precious stones	Montana, Arizona, Nevada, California.
Gold	California, Alaska, Colorado, South Dakota.
Graphite	New York, Texas, Rhode Island, California.
Grindstones and pulpstones	Ohio, West Virginia, Michigan.
Gypsum	New York, Michigan, Ohio, Iowa.
Iron:	
Ore	Minnesota, Michigan, Alabama, New York.
Pig	Pennsylvania, Ohio, Indiana, Illinois.
Lead	Missouri, Idaho, Utah, Oklahoma.
Lime	Pennsylvania, Ohio, Massachusetts, Missouri.
Magnesite (crude)	California.
Manganese ore	Montana, Arkansas, Virginia, Colorado.
Manganiferous ore	Minnesota, Georgia, Nevada, Colorado.
Mica	North Carolina, New Hampshire, Virginia, New Mexico.
Millstones	New York, New Hampshire, North Carolina, Virginia.
Mineral paints:	
Natural pigments	Canvass discontinued.
Zinc and lead pigments	Pennsylvania, Missouri, Wisconsin, Illinois.
Mineral waters	Wisconsin, New York, California, Maine.
Natural gas	West Virginia, Pennsylvania, Oklahoma, Ohio.
Natural-gas gasoline	Oklahoma, West Virginia, California, Texas.
Nickel	Not separable by States.
Oilstones, etc	Arkansas, Ohio, Indiana, Vermont.
Peat	California, New Jersey, Illinois, New York.
Petroleum	California, Oklahoma, Texas, Kansas.

Mineral products of the United States and leading producing States in 1921—Continued.

Mineral.	Principal producing States in order of value.
Phosphate rock	Florida, Tennessee, Kentucky, Idaho.
Platinum and allied metals	California, Alaska, Oregon.
Potash (K_2O)	California, Utah, Maryland, Nebraska.
Pumice	Kansas, Nebraska, California.
Pyrites	California, New York, Colorado, Wisconsin.
Quicksilver	Texas, California, Nevada, Oregon.
Salt	Michigan, New York, Ohio, Kansas.
Sand and gravel	Pennsylvania, Ohio, Illinois, New York.
Sand-lime brick	Michigan, Wisconsin, Florida, District of Columbia.
Silica (quartz)	Wisconsin, Connecticut, California, New York.
Silver	Utah, Nevada, Montana, Idaho.
Slate	Pennsylvania, Vermont, New York, Maine.
Stone	Pennsylvania, Indiana, New York, Ohio.
Sulphur	Texas, Louisiana, Nevada, Utah.
Sulphuric acid from copper and zinc smelters.	Tennessee, Illinois, Pennsylvania, Kansas.
Talc and soapstone	Virginia, New York, Vermont, California.
Tin	Alaska.
Titanium ore (rutile)[a]	Virginia.
Tungsten ore[a]	Colorado.
Uranium and vanadium ores	Colorado, Utah.
Zinc	Oklahoma, New Jersey, Kansas, Montana.

[a] 1920. No production in 1921.

Mineral-producing States and their leading mineral products in 1921.

State.	Principal mineral products in order of value.
Alabama	Coal, iron ore, cement, clay products.
Alaska	Gold, copper, silver, coal.
Arizona	Copper, gold, silver, asbestos.
Arkansas	Petroleum, coal, natural gas, stone.
California	Petroleum, cement, natural gas, gold.
Colorado	Coal, gold, silver, clay products.
Connecticut	Clay products, stone, lime, sand and gravel.
Delaware	Clay products, stone, sand and gravel.
District of Columbia	Clay products, sand and gravel, sand-lime brick, stone.
Florida	Phosphate rock, fuller's earth, stone, clay products.
Georgia	Clay products, stone, fuller's earth, cement.
Idaho	Lead, silver, gold, stone.
Illinois	Coal, petroleum, clay products, cement.
Indiana	Coal, cement, clay products, stone.
Iowa	Coal, cement, clay products, gypsum.
Kansas	Petroleum, coal, natural gas, cement.
Kentucky	Coal, petroleum, clay products, stone.
Louisiana	Petroleum, sulphur, natural gas, natural-gas gasoline.
Maine	Stone, lime, clay products, slate.
Maryland	Coal, cement, clay products, sand and gravel.
Massachusetts	Stone, clay products, lime, sand and gravel.
Michigan	Iron ore, copper, cement, salt.
Minnesota	Iron ore, clay products, cement, stone.
Mississippi	Sand and gravel, clay products, mineral waters, stone.
Missouri	Lead, coal, clay products, cement.
Montana	Coal, silver, copper, petroleum.
Nebraska	Clay products, cement, sand and gravel, stone.
Nevada	Silver, gold, gypsum, copper.
New Hampshire	Stone, clay products, sand and gravel, mica.
New Jersey	Clay products, zinc, cement, stone.
New Mexico	Coal, copper, silver, clay products.
New York	Clay products, cement, stone, salt.
North Carolina	Clay products, stone, sand and gravel, feldspar.
North Dakota	Coal, clay products, mineral waters, sand and gravel.
Ohio	Coal, clay products, petroleum, natural gas.
Oklahoma	Petroleum, natural gas, natural-gas gasoline, coal.
Oregon	Cement, sand and gravel, stone, gold.
Pennsylvania	Coal, cement, natural gas, clay products.
Rhode Island	Stone, clay products, lime, mineral waters.
South Carolina	Stone, clay products, sand and gravel, mineral waters.
South Dakota	Gold, stone, sand and gravel, silver.
Tennessee	Coal, cement, clay products, stone.
Texas	Petroleum, sulphur, natural-gas gasoline, natural gas.
Utah	Coal, silver, lead, copper.
Vermont	Stone, slate, lime, talc.
Virginia	Coal, clay products, cement, stone.
Washington	Coal, cement, clay products, sand and gravel.
West Virginia	Coal, natural gas, petroleum, clay products.
Wisconsin	Stone, sand and gravel, mineral waters, lime.
Wyoming	Petroleum, coal, natural gas, natural-gas gasoline.

Prices of silver, copper, lead, and zinc, 1912–1921.

Year.	Silver.[a]	Copper.[b]	Lead.[c]	Zinc.[d]	Year.	Silver.[a]	Copper.[b]	Lead.[c]	Zinc.[d]
	Troy oz.	*Pound.*	*Pound.*	*Pound.*		*Troy oz.*	*Pound.*	*Pound.*	*Pound.*
1912	$0.615	$0.165	$0.045	$0.069	1917	$0.824	$0.273	$0.086	$0.102
1913	.604	.155	.044	.056	1918	.98	.247	.071	.091
1914	.553	.133	.039	.051	1919	1.12	.186	.053	.073
1915	.507	.175	.047	.124	1920	1.09	.184	.080	.081
1916	.658	.246	.069	.134	1921	1.00	.129	.045	.050

[a] Average price furnished by Bureau of the Mint.
[b] For 1912–1915, U. S. Geological Survey computation for electrolytic copper based on quotations by technical journals. For 1916 and later years, average price, all marketable grades.
[c] For 1912–1915, New York price, U. S. Geological Survey computation from daily market spot quotations. For 1916, from outside spot quotations at New York. For 1917 and later years, average price.
[d] For 1912–1914, St. Louis price. U. S. Geological Survey computation from daily market spot quotations. For 1915 and later years, average price, all grades.

DETAILED TABLES.

ABRASIVE MATERIALS.

PRODUCTION.

Natural abrasives sold by producers in the United States, 1919–1921.

Abrasive.	1919		1920		1921	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Millstones	(a)	$66,972	(a)	$63,325	(a)	$24,524
Grindstones and pulpstones	46,865	1,336,015	53,484	1,707,004	26,340	1,227,322
Oilstones and scythestones	1,463	235,943	1,144	231,747	831	173,025
Emery	2,601	23,203	2,327	21,685	305	2,250
Garnet	4,944	310,131	5,476	434,425	3,048	260,687
Abrasive quartz and feldspar	(b)	(b)	(b)	(b)	(b)	(b)
Diatomaceous (infusorial) earth and tripoli[c]	66,934	713,501	102,155	1,649,370	67,474	895,629
Pumice	36,051	116,835	41,838	114,433	37,108	158,540
Grinding pebbles Tube-mill lining	9,448	85,302	10,924	77,823	989	14,637
	.....	2,887,902	.....	4,299,812	.....	2,756,614

[a] Figures not available, as product was not reported by weight.
[b] See sections on feldspar and silica.
[c] Includes rottenstone and for 1921 an estimate for part of diatomaceous earth.

IMPORTS AND EXPORTS.

Value of abrasive materials imported for consumption in the United States, 1917–1921.

Material.	1917	1918	1919	1920	1921
Millstones and burrstones	$18,227	$20,017	$26,356	$20,954	$13,556
Grindstones and pulpstones	57,950	27,361	50,551	77,046	81,880
Hones, oilstones, and whetstones	10,636	6,075	12,199	56,416	35,761
Emery and corundum	210,602	614,167	595,203	617,187	393,454
Diatomaceous earth, tripoli, and rottenstone	17,864	11,128	12,545	16,323	13,203
Pumice	147,278	33,014	119,781	249,995	173,201
Diamond dust and bort	349,746	475,870	1,420,442	3,387,488	466,345
	812,303	1,187,632	2,237,077	4,425,409	1,177,400

Value of domestic abrasive materials exported from the United States, 1917–1921.

Material.	1917	1918	1919	1920	1921
Grindstones	$198,772	$210,889	$297,068	$421,322	$281,976
Abrasive wheels, emery, and other	4,481,600	3,862,531	3,032,067	2,791,128	1,318,804
All other	1,941,512	1,982,822	2,809,231	3,810,171	1,719,810
	6,621,884	6,056,242	6,138,366	7,025,621	3,320,590

ALUMINUM.

[See Bauxite and aluminum.]

ANTIMONY AND ANTIMONIAL LEAD.

PRODUCTION.

Mine production of antimony ores in the United States, in short tons.[a]

Year.	Quantity.	Antimony content.
1915	5,000	2,100
1916	4,500	1,770
1917	1,060	390
1918	190	50

[a] Mine production negligible prior to 1915, and no production since 1918.

Smelter production of metallic antimony in the United States, 1917–18.[a]

Year.	From domestic ores.		From foreign ores.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	258	$106,812	2,182	$903,348	2,440	$1,010,160
1918	127	32,004	2,490	627,480	2,617	659,484

[a] Not recorded prior to 1917.

Only two smelters reported production (all from foreign ores) in 1919 and one in 1920, and the Survey is not at liberty to publish the figures. There was no production in 1921.

Secondary antimony and antimony content of secondary alloys recovered from old alloys, scrap, and dross in the United States, 1916–1921.

Year.	Short tons.	Value.[a]	Year.	Short tons.	Value.[a]
1916	4,480	$2,270,016	1919	4,399	$717,900
1917	4,961	2,061,700	1920	5,600	938,560
1918	5,226	1,317,000	1921	4,720	464,400

[a] Values calculated at average yearly price for ordinary brands of antimony as published by the American Metal Market.

By-product antimonial lead produced in the United States from both foreign and domestic ores, 1916–1921.

Year.	Short tons.	Value.	Antimony content (short tons).	Year.	Short tons.	Value.	Antimony content (short tons).
1916	24,038	$4,483,582	3,496	1919	13,874	$1,513,968	1,943
1917	18,646	3,781,560	2,759	1920	12,535	1,963,255	2,033
1918	18,570	2,826,350	2,566	1921	10,064	870,059	1,589

IMPORTS AND EXPORTS.

Antimony imported and entered for consumption in the United States, 1917–1921.

Year.	Antimony ore.[a]			Liquated antimony sulphide.[b]		Metallic antimony.[c]		Antimony oxide and other compounds.[d]	
	Short tons.	Antimony content.		Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
		Short tons.	Value.						
1917	10,083	5,832	$1,006,884	796	$128,660	11,286	$2,829,159	10	$5,368
1918	3,363	1,425	177,731	833	113,258	14,011	3,055,619	18	11,904
1919	993	409	54,477	278	19,202	7,159	1,021,587	126	9,501
1920	1,709	682	70,285	1,375	123,902	9,817	1,216,376	298	25,260
1921	213	98	11,682	353	17,577	10,130	784,146	154	15,558

[a] Classified in tariff classification as "Antimony ore and stibnite containing antimony."
[b] Classified in tariff classification as "Antimony matte, containing not more than 10 per cent of lead."
[c] Classified in tariff classification as "Antimony regulus or metal."
[d] Classified in tariff classification as "Antimony, oxide, salts, and compounds of."

Foreign antimony exported from the United States, 1917–1921.[a]

Year.	Ore.			Matte, regulus, or metal.	
	Short tons.	Antimony content (pounds).	Value.	Pounds.	Value.
1917				989,477	$169,260
1918				1,410,970	164,666
1919	3	5,380	$1,665	429,059	33,913
1920				896,034	51,607
1921				299,776	15,741

[a] There are no domestic exports.

PRICES.

The average New York prices for the ordinary grades of metallic antimony are given by the Engineering and Mining Journal as follows:

Average price (cents per pound) of metallic antimony at New York, 1916–1921, by years.

1916	25.37	1919	8.19
1917	20.69	1920	8.49
1918	12.58	1921	4.96

ARSENIC.

PRODUCTION.

White arsenic (refined and crude) produced in the United States and sold, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	5,986	$555,187	1919	[a] 6,029	[b] $1,181,684
1917	6,151	1,118,313	1920	11,502	2,021,356
1918	[a] 6,323	1,213,000	1921	4,786	717,700

[a] In addition to the arsenious oxide (or white arsenic) metallic arsenic was produced from ore in 1918 and 1919. The totals shown include this metallic arsenic.
[b] Only two companies reported production of white arsenic in 1919, and both have given permission to show quantity but not value. This value has been estimated at 9.8 cents a pound.

IMPORTS AND EXPORTS.

Arsenic compounds imported and entered for consumption in the United States, 1917–1921.

Year.	Arsenic or arsenious acid (white arsenic, As_2O_3).		Arsenic and sulphide of, or orpiment.		Sheep dip.		Paris green and London purple.	
	Short tons.	Value.	Short tons.	Value.	Pounds.	Value.	Pounds.	Value.
1917	1,178	$264,534	2,777	$410,341	(a)	$15,848	48	$189
1918	1,847	441,212	4,842	840,600	(a)	23,538	.....	.....
1919	4,389	624,494	2,151	316,687	146,803	12,346	18	14
1920	3,740	532,635	4,080	684,016	70,168	5,150	772	277
1921	1,669	253,250	3,343	531,322	61,377	6,362	325	123

[a] Figures not available.

Foreign arsenic and sulphide of, or orpiment, exported from the United States, 1916–1921.[a]

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1916	1,761	$1,256	1919	.....	.....
1917	113,600	15,840	1920	13,799	$1,827
1918	80,050	12,017	1921	23,765	2,835

[a] There are no domestic exports.

ASBESTOS.

SUPPLY.

Supplies of asbestos in the United States, 1917–1921.

Year	Domestic shipments.		Imports (unmanufactured.)[a]		Exports (unmanufactured).		Apparent consumption.[b]	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	1,958	$291,014	134,088	$4,521,172	708	$116,580	135,338	$4,695,606
1918	998	118,687	137,700	6,337,608	697	51,053	138,001	6,405,242
1919	1,161	248,265	135,270	7,369,685	1,119	157,416	135,312	7,460,534
1920	1,648	678,231	167,558	9,120,253	615	141,071	168,591	9,657,413
1921	831	336,968	72,463	2,948,302	520	101,600	72,774	3,183,670

[a] Imports for consumption and mainly from Canada.
[b] Production plus imports minus exports.

PRODUCTION.

Domestic asbestos marketed in the United States, 1913–1921, by varieties.

Year.	Chrysotile.		Amphibole.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1913	.....	.....	1,100	$11,000	1,100	$11,000
1914	22	$5,450	1,225	13,515	1,247	18,965
1915	316	65,148	1,415	11,804	1,731	76,952
1916	808	167,683	830	13,311	1,638	180,994
1917	1,391	279,270	567	11,744	1,958	291,014
1918	392	101,059	606	17,628	998	118,687
1919	502	229,265	659	19,000	1,161	248,265
1920	1,245	661,907	403	16,324	1,648	678,231
1921	438	313,268	393	23,700	831	336,968

IMPORTS.

Asbestos (unmanufactured) imported into the United States, 1917–1921, by countries, in short tons.

[General imports.]

Country.	1917	1918	1919	1920	1921	
					Short tons.	Value.
Africa:						
British South Africa	1,791	837	900	2,233	504	$72,980
Portuguese Africa	496	2,049	100	1,584	279	96,250
Australia	.....	.....	.....	3	1	371
Canada	131,525	134,813	133,662	162,717	71,412	2,687,439
Chile	.....	.....	.....	.....	1	212
China	.....	.....	1	17	50	5,187
Colombia	.....	1	.....	.....	.....	.....
England	296	.....	156	746	200	73,264
France	.....	.....	450	.....	.....	.....
Germany	.....	.....	.....	.....	11	10,253
Greece	.....	.....	.....	81	.....	.....
Hongkong	.....	.....	.....	.....	1	227
India, British	.....	.....	1	.....	.....	.....
Italy	.....	.....	.....	3	2	800
Japan	.....	.....	.....	100	1	1,239
Trinidad and Tobago	.....	.....	.....	.....	1	80
Turkey in Asia	.....	.....	.....	74	.....	.....
	134,108	137,700	135,270	167,558	72,463	.....
Total value	$4,521,172	$6,337,585	$7,369,685	$9,120,253	$2,948,302	2,948,302

ASPHALT AND RELATED BITUMENS.

PRODUCTION.

Asphalt produced in the United States from domestic petroleum and sold, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	688,334	$6,178,851	1919	614,692	$8,727,372
1917	701,809	7,734,691	1920	700,496	11,985,457
1918	604,723	8,796,541	1921	624,220	9,048,221

Asphalt produced in the United States from Mexican petroleum and sold, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	572,387	$6,018,851	1919	674,876	$7,711,510
1917	645,613	7,441,813	1920	1,045,779	14,272,862
1918	597,697	9,417,818	1921	908,093	11,761,358

Native asphalt and related bitumens produced in the United States and sold, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	98,477	$923,281	1919	88,281	$682,989
1917	81,604	773,424	1920	198,497	1,213,908
1918	60,034	780,808	1921	296,412	1,985,583

IMPORTS AND EXPORTS.

Asphalt and related bitumens imported for consumption in the United States, 1917–1921.

Year.	Crude asphalt.		Ozokerite.	
	Short tons.	Value.	Short tons.	Value.
1917	187,473	$978,087	450	$90,510
1918	114,686	624,967	905	147,805
1919	104,913	609,923	1,874	454,840
1920	127,027	1,055,951	2,136	499,758
1921	116,450	972,166	4,274	546,054

Year.	Ichthyol.		Bituminous limestone.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	29	$36,232	413	$15,028	188,365	$1,119,857
1918	33	39,452	39	2,528	115,663	814,752
1919	15	38,975	735	5,576	107,537	1,109,314
1920	39	79,133	1,387	11,665	130,599	1,646,507
1921	38	107,752	12,085	157,124	132,847	1,783,096

Asphalt exported from the United States, 1917–1921.

Year.	Unmanufactured.		Manufactures of (value).	Total value.
	Short tons.	Value.		
1917	30,107	$587,256	$585,472	$1,172,728
1918	22,108	577,654	577,936	1,155,590
1919	40,208	1,103,930	606,918	1,710,848
1920	51,706	1,356,116	842,074	2,198,190
1921	45,367	1,178,038	621,224	1,799,262

BARYTES AND BARIUM PRODUCTS.

BARYTES.

SUPPLY.

Supplies of crude barytes in the United States, 1917–1921.

Year.	Domestic barytes marketed.		Imports for consumption.		Apparent consumption.[a]	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	206,888	$1,171,184	6	$63	206,894	$1,171,247
1918	155,368	1,044,905	.....	.....	155,368	1,044,905
1919	209,330	1,727,822	118	594	209,448	1,728,416
1920	228,113	2,142,464	24,874	146,858	252,987	2,289,322
1921	66,369	531,958	11,054	59,371	77,423	591,329

[a] No exports reported. Stocks at plants included, but those at mines excluded.

PRODUCTION.

Crude domestic barytes marketed in the United States in 1920 and 1921, by States.

State.	1920			1921		
	Short tons.	Value.	Average value.	Short tons.	Value.	Average value.
California	2,250	$20,850	$9.27	942	$5,084	$5.40
Georgia	84,644	790,362	9.34	24,614	191,442	7.78
Missouri	99,654	1,013,570	10.17	25,200	217,913	8.65
Tennessee	29,319	213,657	7.29	8,180	61,148	7.48
Other States [a]	12,246	104,025	8.49	7,433	56,371	7.58
	228,113	2,142,464	9.39	66,369	531,958	8.02

[a] 1920: Alabama, Illinois, Kentucky, Nevada, North Carolina, South Carolina, Virginia, and Wisconsin; 1921: Alabama, Illinois, North Carolina, South Carolina, and Virginia.

CONSUMPTION.

Crude domestic and foreign barytes used in the manufacture of barium products in the United States, 1917–1921, in short tons.

Year.	In manufacture of—		
	Ground barytes.	Lithopone.	Barium chemicals.
1917	60,132	86,065	49,842
1918	62,440	85,282	38,041
1919	64,922	103,688	32,976
1920	79,052	113,181	37,210
1921	28,296	61,359	10,952

BARIUM PRODUCTS.

PRODUCTION.

Barium products of domestic manufacture (from either domestic or imported crude ore, marketed [a] in the United States, 1917–1921, in short tons.

Product.	1917	1918	1919 [a]	1920	1921
Ground barytes	52,694	55,086	57,985	65,748	27,661
Lithopone	63,713	62,403	79,643	89,373	55,016
Barium chemicals [b]	22,503	23,186	20,013	20,760	5,487
	138,910	140,675	157,641	175,881	88,164

[a] Figures for 1919 represent production.
[b] In order to avoid duplication of figures, barium chemicals manufactured from secondary products bought in open market are not included in table.

Barium chemicals of domestic manufacture marketed in the United States, 1917–1921, in short tons.

Chemical.	1917	1918	1919	1920	1921
Barium carbonate	8,238	7,661	7,135	7,484	1,956
Barium chloride	4,870	4,530	4,509	3,084	(a)
Barium nitrate	165	(a)	(a)	(a)	.....
Barium sulphate (blanc fixe)	6,314	9,522	5,227	8,046	2,471
Other barium chemicals [b]	2,916	1,473	3,142	2,146	1,060
	22,503	23,186	20,013	20,760	5,487

[a] Included under "Other barium chemicals."
[b] 1917: Binoxide, hydroxide, and sulphide; 1918: Binoxide, hydroxide, nitrate, and sulphide; 1919: Binoxide, nitrate, and sulphide; 1920: Binoxide, hydroxide, nitrate, and sulphide; 1921: Chloride, hydroxide, and sulphide.

IMPORTS.

Barium products imported and entered for consumption in the United States, 1917–1921.

Product.	1917	1918	1919	1920	1921	
					Short tons.	Value.
Manufactured barytes	$1,743	.....	.....	$3,017	1,002	$16,942
Lithopone	29,199	.....	$122,708	263,240	5,247	432,019
Barium carbonate:						
Natural (ground witherite)	17,321	$14,134	4,739	61,284	668	25,188
Manufactured (chemically precipitated)	1,554	.....	2,666	37,462	2,238	80,603
Barium binoxide	.....	.....	.....	64,447	669	127,631
Barium chloride	.....	.....	19,846	151,778	2,187	72,621
Blanc fixe, or barium sulphate (chemically precipitated)	3,333	.....	90	8,485	769	22,470
	53,150	14,134	150,049	589,713	12,780	777,474

BAUXITE AND ALUMINUM.

BAUXITE.

Bauxite supplies in the United States, 1917–1921.

Year.	Domestic production.					
	Georgia, Alabama, and Tennessee.		Arkansas.		Total.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
1917	62,134	$395,051	506,556	$2,724,007	568,690	$3,119,058
1918	42,829	314,112	562,892	3,133,880	605,721	3,447,992
1919	43,076	346,588	333,490	1,855,159	376,566	2,201,747
1920	40,029	349,453	481,279	2,897,892	521,308	3,247,345
1921	14,700	134,400	124,850	755,400	139,550	889,800

Year.	Imports.		Exports.[a]		Apparent domestic consumption.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
1917	7,691	$28,989	21,791	$1,323,926	554,590	$1,824,121
1918	3,653	14,791	19,711	1,523,688	589,663	1,939,095
1919	6,082	36,820	17,701	1,372,094	364,947	866,473
1920	42,895	251,284	22,257	1,843,596	541,946	1,655,033
1921	27,587	164,589	5,942	488,785	161,195	565,604

[a] Includes bauxite concentrates.

ALUMINUM.

PRODUCTION.

Value of aluminum produced in the United States, 1916–1921.[a]

Year.	Primary metal.	Secondary metal.	Year.	Primary metal.	Secondary metal.
1916	$33,900,000	$23,430,200	1919	$38,558,000	$12,014,600
1917	45,882,000	16,711,800	1920	41,375,000	9,489,100
1918	41,159,000	10,113,600	1921	10,906,000	3,775,400

[a] Value of primary metal based on average open market price, at New York, as quoted by the Engineering and Mining Journal, and that of secondary aluminum on average price at New York, as given by American Metal Market.

IMPORTS AND EXPORTS.

Aluminum imported for consumption in the United States, 1917–1921.

Year.	Crude and semicrude.[a]		Manufactures of.[b]	Total value.
	Pounds.	Value.		
1917	89,291	$35,386	$21,504	$56,890
1918	1,690,683	533,704	20,882	554,586
1919	13,852,065	4,530,579	38,016	4,568,595
1920	39,298,649	12,183,891	893,131	13,077,022
1921	32,559,017	7,627,508	1,262,283	8,889,791

[a] Includes crude aluminum, plates, sheets, and wire.
[b] Includes aluminum leaf, kitchen utensils, and all other manufactures of aluminum.

Aluminum and manufactures of aluminum exported from the United States, 1917–1921.

Year.	Crude and semicrude.[a]		Manufactures of.	Total value.
	Pounds.	Value.		
1917 Jan.-June			$9,029,458	$14,586,467
1917 July-Dec	10,020,404	$4,571,193	985,816	
1918	24,135,234	8,979,315	1,890,073	10,869,388
1919	5,020,352	1,744,896	2,145,430	3,890,326
1920	9,407,631	3,067,617	2,563,164	5,630,781
1921	2,196,378	801,075	2,307,782	3,108,857

[a] Includes ingots, metal and alloys, plates and sheets.

PRICES.

Average open-market price, small lots of aluminum, in the United States, 1916–1921, in cents per pound.[a]

1916	60.71	1919	32.38
1917	51.59	1920	33.07
1918	33.42	1921	[b] 26.10

[a] Engineering and Mining Journal quotations.
[b] Domestic aluminum; foreign grades 2 to 3 cents less.

BISMUTH.

PRODUCTION.

Bismuth was produced by four companies in 1921, but only three made reports, and only one was willing to have the totals published. The production was less than in 1920. The sales did not exceed 232,000 pounds, valued approximately at $396,000. The bismuth produced in the United States is almost entirely a by-product obtained in the refining of lead bullion.

IMPORTS AND EXPORTS.

Bismuth imported for consumption in the United States, 1916–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1916	76,723	$195,975	1919	57,607	$55,179
1917	69,250	142,300	1920	72,771	161,877
1918	135,700	277,273	1921	94,085	114,891

No exports of bismuth are recorded.

BORAX.

[See Sodium compounds.]

BRIQUETS (FUEL).

Fuel briquets produced in the United States, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	295,155	$1,445,662	1919	295,734	$2,301,054
1917	406,856	2,233,888	1920	567,192	4,623,831
1918	477,235	3,212,793	1921	398,949	3,632,301

BROMINE.

PRODUCTION.

Bromine marketed in the United States, 1916–1921.

Year.	Pounds.	Value.	Average value.	Year.	Pounds.	Value.	Average value.
1916	728,520	$951,932	$1.31	1919	1,854,971	$1,234,969	$0.67
1917	895,499	492,703	.55	1920	1,160,584	745,381	.64
1918	1,727,156	970,099	.56	1921	711,953	172,759	.24

IMPORTS AND EXPORTS.

Imports of bromine in 1921 were 300 pounds, valued at $84. None were recorded for 1920.

Exports are not specifically shown.

CADMIUM.

PRODUCTION.

Metallic cadmium and cadmium sulphide produced in the United States, 1917–1921.

Year.	Metallic cadmium.			Cadmium sulphide.		
	Pounds.	Value.	Average value.	Pounds.	Value.	Average value.
1917	207,408	$305,097	$1.47	50,169	$70,939	$1.41
1918	127,164	188,203	1.48	51,702	70,315	1.36
1919	99,939	121,926	1.22	31,197	37,436	1.20
1920	129,283	151,261	1.17	32,133	37,274	1.16
1921	65,101	63,799	.98	65,446	71,336	1.09

IMPORTS AND EXPORTS.

Imports of cadmium in 1921 for consumption were 101 pounds, valued at $216. No cadmium was imported from 1916 to 1920, inclusive.

Exports of cadmium are not separately recorded.

CALCIUM CHLORIDE.

PRODUCTION.

Calcium-magnesium chloride marketed in the United States, 1916–1921.

Year.	Short tons.	Value.	Average value.	Year.	Short tons.	Value.	Average value.
1916	27,709	$224,997	$8.12	1919	26,123	$321,596	$12.31
1917	30,503	451,480	14.80	1920	27,849	539,471	19.37
1918	26,624	503,452	18.91	1921	23,672	510,723	21.57

IMPORTS AND EXPORTS.

Imports and exports of calcium chloride are not specifically shown.

CARBON BLACK.

Carbon black produced from natural gas in the United States, 1919–1921.

Year.	Number of plants.	Carbon black produced.				Gas used.
		Pounds.	Value.	Average value (cents).	Average yield of carbon black per M cubic feet (pounds).	M cubic feet.
1919	36	52,056,941	$3,816,040	7.3	1.0	49,896,235
1920	35	51,321,892	4,032,286	7.9	1.3	40,598,978
1921	41	59,766,315	5,445,878	9.1	1.2	50,565,033

CEMENT.

SUPPLY.

Supplies of Portland cement in the United States, 1917–1921.

Year.	Domestic shipments.		Imports.		Exports.		Apparent consumption. [a]	
	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.	Barrels.	Value
1917	90,703,474	$122,775,088	2,323	$6,076	2,586,215	$5,328,536	88,119,582	$117,452,628
1918	70,915,508	113,316,275	305	1,200	2,252,446	5,912,166	68,663,367	107,405,309
1919	85,612,899	146,734,844	8,931	52,636	2,463,573	7,513,389	83,158,257	139,274,091
1920	96,311,719	194,439,025	524,601	1,254,729	2,985,807	10,045,369	93,850,516	185,648,385
1921	95,507,147	180,778,415	122,322	388,842	1,181,014	4,276,986	94,448,455	176,890,271

[a] Domestic shipments plus imports minus exports.

PRODUCTION.

Principal hydraulic cements produced in the United States, 1917–1921.

Year.	Natural and puzzolan cements.		Portland cement.		Total.	
	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.
1917	639,456	$435,370	92,814,202	$125,670,430	93,453,658	$126,105,800
1918	432,966	401,341	71,081,663	113,730,661	71,514,629	114,132,002
1919	528,589	583,554	80,777,935	138,130,269	81,306,524	138,713,823
1920	767,481	1,150,890	100,023,245	202,046,955	100,790,726	203,197,845
1921	539,402	897,025	98,842,049	186,811,473	99,381,451	187,708,498

Portland cement produced, shipped, and in stock in the United States in 1921, by States.

State.	Production (barrels).	Shipments.			Stock (barrels).
		Barrels.	Value.	Average factory price.	
Alabama	1,743,287	1,714,286	$3,466,223	$2.02	68,638
California	7,302,784	7,180,700	16,856,258	2.35	561,175
Illinois	5,587,825	5,237,510	9,092,982	1.74	753,954
Iowa	4,590,920	4,151,439	7,439,983	1.79	993,090
Kansas	3,781,494	3,643,582	7,253,944	1.99	536,971
Michigan	5,777,533	5,680,156	10,300,289	1.81	760,503
Missouri	4,446,091	4,375,712	8,034,540	1.84	641,580
New Jersey	2,803,774	2,840,699	4,820,538	1.70	245,241
New York	5,294,188	4,993,341	9,403,015	1.88	790,056
Ohio	2,563,773	2,518,723	4,615,492	1.83	238,676
Oklahoma	1,631,525	1,596,566	3,420,093	2.14	142,644
Pennsylvania	27,628,598	26,622,367	46,881,625	1.76	3,413,359
Texas	2,668,741	2,514,045	5,902,863	2.35	296,296
Washington	1,678,863	1,612,891	4,080,785	2.53	255,292
Other States[a]	21,342,653	20,825,130	39,209,785	1.88	2,489,889
	98,842,049	95,507,147	180,778,415	1.89	12,187,364

[a] Colorado, Georgia, Indiana, Kentucky, Maryland, Minnesota, Montana, Nebraska, Oregon, Tennessee, Utah, Virginia, and West Virginia.

PRICES.

The average factory price of Portland cement per barrel in bulk in 1921 was $1.89, as compared with $2.02 in 1920. The price in 1921 is the highest, with the exception of 1920, for Portland cement that has been realized since 1893, when $1.96 was recorded. The lowest average price, $0.813, was recorded in 1909 and 1912.

CHROMITE.

SUPPLY.

Supplies of chromite in the United States, 1917–1921.

Year.	Domestic shipments.		Imports.		Apparent consumption.[a]	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
1917	43,725	$1,049,400	72,063	$1,110,659	115,788	$2,160,059
1918	82,430	3,955,567	100,142	2,892,825	182,572	6,848,392
1919	5,079	129,302	61,404	1,381,497	66,483	1,510,799
1920	2,502	44,857	150,275	1,921,824	152,777	1,966,681
1921	282	2,900	81,836	654,602	82,118	657,502

[a] There are no exports of chromite.

PRODUCTION.

Crude chromite produced by different countries, 1916–1920, in metric tons.

[For more complete data, see pp. 513–564.]

Country.	1916	1917	1918	1919	1920
Austria-Hungary [a]	(b)	12,600	(b)	(b)	.....
Australia [c]	621	1,142	611	254	(b)
Brazil [d]	.....	.....	18,141	4,877	3,506
Canada [e]	24,963	33,317	19,952	8,678	9,993
Cuba [d]	35	17	8,963	14,693	721
Great Britain [f]	392	303	142	152	1,118
Greece [g]	10,447	9,600	2,640	4,070	(b)
Guatemala [d]	.....	182	1,212	1,686	1,140
India [h]	20,484	27,495	58,697	37,024	(b)
Japan [i]	8,278	8,941	6,247	6,012	(b)
New Caledonia [j]	74,715	41,892	55,177	23,548	60,000
Norway [k]	2,757	3,975	2,783	(b)	(b)
Rhodesia [l]	80,622	66,190	28,382	32,007	54,674
Russia [m]	15,000	(b)	.....	.....	.....
Turkey (Asia Minor) [n]	14,000	(b)	(b)	3,500	25,000
United States	47,790	44,427	83,753	5,161	2,542
	300,104	250,081	286,700	141,662	[p] 190,000

[a] 1917: Min. Jour., London, Dec. 18, 1920 (Production for Hungary); 1920: Estimate.
[b] Figures not yet available.
[c] New South Wales Dept. Mines Ann. Repts.; Queensland Undersecretary for mines Ann. Repts.
[d] Imports into United States, Bur. Foreign and Domestic Commerce.
[e] Canada Dept. Mines, Mines Branch Ann. Repts.
[f] Great Britain, Mines and Quarries, General Reports, pt. 3.
[g] 1916–1917: Tableaux statistiques du mouvement minier de la Grèce; 1918–1919: Information from United States consulate general, Athens, Greece, Aug. 31, 1920; 1920: Information furnished by Direction du Service des Mines, Athens, Greece.
[h] 1916–1918: India Geol. Survey Records; 1919: Preliminary statement by director India Geol. Survey.
[i] 1916–1917: Résumé statisque de l'empire du Japon; 1918–1919: Mining Industry, Japan Dept. Commerce, Bur. Mines.
[j] 1916: Mineral Industry, 1919; 1917: Bulletin de l'Agence des Colonies; 1918: Statistique de l'Industrie Minerale en France et en Algerie; 1919: Exports; 1920: Estimate.
[k] Norges Bergverksdrift.
[l] Report of Secretary of Mines, Rhodesia.
[m] Estimate.
[n] Estimates. 1920: On basis, largely, of information furnished by E. J. Lavino & Co., importers.
[p] Including estimates for those countries for which figures are not yet available.

IMPORTS.

Crude chromite imported into the United States, 1917–1921, by countries, in long tons.

Country.	1917	1918	1919	1920	1921
Australia	.....	15,976	13,161	2,778	.....
Belgium	.....	.....	.....	239	.....
Brazil	.....	17,854	4,800	3,451	.....
British South Africa	4,750	521	29	39,400	23,318
Canada	19,012	20,949	8,941	8,491	7,554
Cuba	17	8,821	14,461	710	600
England	5	4	.....	3,799	.....
French Oceania [a]	10,300	25,761	7,125	[a] 50,314	35,108
Germany	.....	.....	.....	1	.....
Greece	.....	.....	.....	5,302	8,104
Guatemala	179	1,193	1,659	1,122	401
India	.....	.....	.....	4,500	928
New Zealand	.....	.....	693	.....	.....
Other British Oceania	.....	1,063	.....	.....	.....
Peru [a]	.....	.....	.....	[a] 6,368	.....
Portuguese Africa	37,800	8,000	4,000	11,000	.....
Spain	.....	.....	3,035	40	.....
Turkey in Asia	.....	.....	3,500	12,760	5,822
Turkey in Europe	.....	.....	.....	.....	1
	72,063	100,142	61,404	150,275	81,836

[a] The Bureau of Foreign and Domestic Commerce reports that the ore listed under Peru should be credited to French Oceania.

CLAY.

PRODUCTION.

Domestic clay marketed in the United States, 1917–1921.

Year.	Kaolin.		Paper clay.		Slip clay.		Ball clay.		Fire clay.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	31,885	$301,378	174,449	$962,421	16,972	$70,505	107,406	$569,240	2,347,972	$5,625,095
1918	37,969	391,109	141,725	1,068,420	13,552	49,898	89,896	590,631	2,305,033	5,664,064
1919	38,758	490,510	114,070	985,171	5,149	17,556	65,026	520,849	1,755,331	4,628,605
1920	[a]268,203	[a]2,865,407	(a)	(a)	9,006	41,519	69,477	584,611	2,341,076	7,425,674
1921	[a]162,726	[a]1,579,163	(a)	(a)	4,608	14,841	54,014	354,565	1,195,861	3,560,373

Year.	Stoneware clay.		Brick clay.		Miscellaneous clay.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	81,352	$113,839	93,779	$94,703	260,029	$305,365	3,113,844	$8,042,546
1918	86,800	147,098	(b)	(b)	301,386	421,421	2,976,361	8,332,641
1919	60,236	80,367	(b)	(b)	236,530	367,573	2,275,100	7,090,631
1920	106,350	229,221	(b)	(b)	322,100	467,856	3,116,212	11,614,288
1921	86,574	184,540	(b)	(b)	212,963	331,818	1,716,746	6,025,300

[a] Paper clay included under "Kaolin."
[b] Included under "Miscellaneous clay."

IMPORTS AND EXPORTS.

Clay imported and entered for consumption in the United States, 1917–1921.

Year.	Kaolin or china clay.			Common blue and Gross-Almerode glass-pot clay.		All other clays.				Total.	
						Unwrought.		Wrought.			
	Short tons.	Value.	Average value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	241,029	$1,315,769	$5.46	88	$709	26,581	$123,439	338	$2,142	268,036	$1,442,059
1918	168,100	1,153,240	6.86	114	983	26,984	163,484	137	1,087	195,335	1,318,794
1919	180,592	1,965,393	10.88	4	133	23,759	187,550	498	4,262	204,853	2,157,338
1920	361,800	3,568,677	9.86	6,837	157,201	34,252	272,524	691	10,267	403,580	4,008,669
1921	162,906	1,546,286	9.49	4,468	77,217	41,421	348,870	120	2,313	208,915	1,974,685

Domestic clay exported from the United States, 1917–1921.

Year.	Fire clay.		All other.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	54,023	$268,093	29,194	$178,764	83,217	$446,857
1918	60,206	333,880	24,348	192,053	84,554	525,933
1919	37,486	262,501	30,983	249,571	68,469	512,072
1920	54,125	393,177	66,035	775,222	120,160	1,168,399
1921	23,666	177,979	23,779	183,449	47,445	361,428

CLAY PRODUCTS.

PRODUCTION.

Value of the clay products of the United States, 1920 and 1921, by products.

Product.	1920	1921 [a]
Common brick	$82,216,230	$57,083,313
Vitrified brick or block	12,678,557	12,870,174
Face brick	19,440,968	18,130,903
Fancy or ornamental brick	71,081	102,093
Enameled brick	1,040,323	1,180,544
Draintile	12,524,641	8,249,721
Sewer pipe	25,371,015	22,275,697
Architectural terra cotta	10,851,902	9,051,138
Fireproofing and hollow building tile	27,112,007	14,858,780
Tile (not drain)	12,470,036	12,558,406
Stove lining	779,710	792,253
Fire brick	53,415,888	24,833,297
Miscellaneous	8,981,068	4,308,147
Total brick and tile	266,953,426	186,294,766
Total pottery	106,716,676	84,102,988
Grand total	373,670,102	270,397,754

[a] Canvass discontinued by Geological Survey after 1920. Figures for 1921 obtained through cooperation with Bureau of the Census.

IMPORTS AND EXPORTS.

Value of clay products imported and entered for consumption in the United States, 1917–1921.

Year.	Pottery.								Brick, fire brick, tile, and miscellaneous clay products.	Grand total.
	Brown earthen and common stone ware. [a]	Tobacco pipes and pipe bowls of clay.	Earthenware and crockery composed of a non-vitrified absorbent body.		China and porcelain.		Sanitary earthenware decorated and not decorated.	Total.		
			Not decorated.	Decorated.	Not decorated.	Decorated.				
1917	$518,965	$8,209	$235,104	$1,960,150	$157,658	$3,409,527	$43,701	$6,333,314	$309,259	$6,642,573
1918	436,207	4,716	317,501	2,147,486	200,328	3,269,008	18,334	6,393,580	290,620	6,684,200
1919	293,120	15,852	350,644	2,476,210	359,560	3,726,695	7,980	7,230,061	196,839	7,426,900
1920	390,962	12,091	340,676	3,805,955	431,636	5,856,384	13,068	10,850,772	419,098	11,269,870
1921	288,893	11,535	405,370	3,871,554	646,427	6,918,179	12,067	12,154,025	297,699	12,451,724

[a] Including Rockingham ware and miscellaneous pottery products.

Value of clay products of domestic manufacture exported from the United States, 1917–1921.

Year.	Building brick.	Fire brick.	Tile (except drain).	Earthen and stone ware.	China.	Sanitary earthenware.	All other.	Total.
1917	$196,207	$4,011,546	$450,422	$805,784	$422,641	$323,558	$743,105	$6,953,263
1918	117,263	5,001,057	582,051	783,577	318,448	377,527	752,651	7,932,574
1919	248,690	2,747,512	628,836	1,148,051	523,861	563,734	721,600	6,582,284
1920	382,814	4,200,266	1,025,083	1,241,938	816,817	778,714	951,991	9,397,623
1921	415,402	2,314,911	814,456	1,014,329	312,161	535,506	873,182	6,279,947

COAL.

PRODUCTION.

Coal produced in the United States, 1917–1921.

Year.	Pennsylvania anthracite.		Bituminous.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	99,611,811	$283,650,723	551,790,563	$1,249,272,837	651,402,374	$1,532,923,560
1918	98,826,084	336,480,347	579,385,820	1,491,809,940	678,211,904	1,828,290,287
1919	88,092,201	364,926,950	465,860,058	1,160,616,013	553,952,259	1,525,542,963
1920	89,598,249	434,252,198	568,666,683	2,129,933,000	658,264,932	2,564,185,000
1921	90,473,451	452,304,903	415,921,950	1,199,983,600	506,395,401	1,652,288,600

Coal produced in the United States in 1920 and 1921, by States, in short tons.

State.	1920	1921
Alabama	16,294,099	12,568,899
Alaska	61,111	76,817
Arkansas	2,103,596	1,227,777
Colorado	12,278,225	9,122,760
Illinois	88,724,893	69,602,763
Indiana	29,350,585	20,319,509
Iowa	7,813,916	4,531,392
Kansas	5,926,408	3,466,641
Kentucky	35,690,762	31,588,270
Maryland	4,065,239	1,827,740
Michigan	1,489,765	1,141,715
Missouri	5,369,565	3,551,621
Montana	4,413,866	2,733,958
New Mexico	3,683,440	2,453,482
North Dakota	948,625	864,903
Ohio	45,878,191	31,942,776
Oklahoma	4,849,288	3,362,623
Pennsylvania (bituminous)	170,607,847	116,013,942
Tennessee	6,662,428	4,460,326
Texas	1,615,015	972,839
Utah	6,005,199	4,078,784
Virginia	11,378,606	7,492,378
Washington	3,757,093	2,428,722
West Virginia	89,970,707	72,786,996
Wyoming	9,630,271	7,200,666
Other States [a]	97,943	103,651
Total bituminous	568,666,683	415,921,950
Pennsylvania anthracite	89,598,249	90,473,451
Grand total	658,264,932	506,395,401

[a] California, Georgia, Idaho, North Carolina, Oregon, and South Dakota.

Coal produced in the United States in 1920 and 1921, by States.

1920 (including product but not employees of wagon mines).

State.	Loaded at mines for shipment (short tons).	Sold to local trade and used by employees (short tons).	Used at mines for steam and heat (short tons).	Made into coke at mines (short tons).	Total production.			Number of employees.				Average number of days worked.
					Short tons.	Value.	Average value.	Underground.		Surface.	Total.	
								Miners, loaders, and shot-firers.	All others.			
Alabama	14,757,143	352,196	481,727	703,033	16,294,099	$59,410,000	$3.65	13,647	6,708	5,185	25,540	247
Alaska	58,522	128	2,461	.....	61,111	356,000	5.83	85	20	102	207	240
Arkansas	2,019,916	13,196	70,484	.....	2,103,596	9,592,000	4.56	2,390	964	612	3,966	176
California and Idaho	208	2,540	5	.....	2,753	12,000	4.36	5	3	2	10	181
Colorado	11,250,746	453,969	291,522	281,988	12,278,225	42,829,000	3.49	7,543	3,462	2,706	13,711	255
Georgia	15,961	791	3,600	29,804	50,156	251,000	5.00	69	28	51	148	294
Illinois	82,574,029	3,766,533	2,384,331	.....	88,724,893	273,509,000	3.08	53,363	23,630	10,091	87,084	213
Indiana	27,615,568	1,000,968	734,049	.....	29,350,585	92,867,000	3.16	18,593	8,329	4,233	31,155	192
Iowa	6,929,214	711,187	173,515	.....	7,813,916	30,794,000	3.94	7,677	3,080	1,148	11,905	250
Kansas	5,586,816	171,162	168,430	.....	5,926,408	22,923,000	3.87	5,827	1,762	1,395	8,984	204
Kentucky	33,465,161	1,081,196	697,434	446,971	35,690,762	146,576,000	4.11	26,006	14,030	9,416	49,452	182
Maryland	3,915,333	108,311	41,595	.....	4,065,239	18,815,000	4.63	3,283	1,347	918	5,548	207
Michigan	1,386,686	15,481	87,598	.....	1,489,765	7,346,000	4.93	1,332	595	227	2,154	261
Missouri	4,811,598	420,318	137,649	.....	5,369,565	22,230,000	4.16	4,842	2,023	1,973	8,838	233
Montana	4,082,281	156,816	174,769	.....	4,413,866	13,923,000	3.16	2,304	1,120	780	4,204	250
New Mexico	3,147,268	43,376	38,852	453,944	3,683,440	13,568,000	3.68	1,858	1,082	798	3,738	302
North Carolina	8,660	.....	2,880	.....	11,540	81,000	7.02	25	15	10	50	288
North Dakota	746,289	164,757	37,579	.....	948,625	2,724,000	2.87	526	227	357	1,110	218
Ohio	42,254,891	2,794,011	828,522	767	45,878,191	175,081,000	3.82	29,938	12,124	8,795	50,857	188
Oklahoma	4,600,437	54,902	193,949	.....	4,849,288	23,294,000	4.80	4,415	2,463	1,366	8,244	217
Oregon	12,980	1,609	6,128	.....	20,717	93,000	4.49	34	22	29	85	307
Pennsylvania (bituminous)	136,745,063	6,300,442	3,508,576	24,053,766	170,607,847	642,630,000	3.77	98,540	45,336	30,094	173,970	244
South Dakota	232	12,545	.....	.....	12,777	46,000	3.60	22	15	10	47	133
Tennessee	6,055,946	136,623	159,461	310,398	6,662,428	26,778,000	4.02	6,491	2,736	2,126	11,353	234
Texas	1,575,709	5,523	33,783	.....	1,615,015	6,062,000	3.75	1,882	691	377	2,950	242
Utah	5,454,967	57,830	104,819	387,583	6,005,199	19,350,000	3.22	2,421	1,138	945	4,504	252
Virginia	9,353,822	299,273	103,012	1,622,499	11,378,606	45,446,000	3.99	5,937	4,616	3,457	14,010	262
Washington	3,470,784	87,663	150,770	47,876	3,757,093	14,560,000	3.88	2,387	1,579	1,028	4,994	260
West Virginia	83,712,005	2,953,638	1,035,460	2,269,604	89,970,707	390,046,000	4.34	50,236	32,657	20,057	102,950	198
Wyoming	9,264,825	122,451	242,995	.....	9,630,271	28,741,000	2.98	3,982	2,350	1,447	7,779	264
Total bituminous	504,873,060	21,289,435	11,895,955	30,608,233	568,666,683	2,129,933,000	3.75	355,660	174,152	109,735	639,547	220
Pennsylvania anthracite	76,844,055	2,896,502	9,857,692	.....	89,598,249	434,252,198	4.85	63,339	37,684	44,051	145,074	271
Grand total	581,717,115	24,185,937	21,753,647	30,608,233	658,264,932	2,564,185,000	3.90	418,999	211,836	153,786	784,621	230

Coal produced in the United States in 1920 and 1921, by States—Continued.

1921 (excluding product of wagon mines.)

State.	Loaded at mines for shipment (short tons).	Sold to local trade and used by employees (short tons).	Used at mines for steam and heat (short tons).	Made into coke at mines (short tons).	Total production.			Number of employees.				Average number of days worked.
					Short tons.	Value.	Average value.	Underground.		Surface.	Total.	
								Miners, loaders, and shot-firers.	All others.			
Alabama	11,834,609	313,125	292,807	128,358	12,568,899	$38,713,000	$3.08	15,304	5,869	4,636	25,809	166
Alaska	71,999	3,005	1,813	.....	76,817	496,000	6.46	104	79	218	401	244
Arkansas	1,174,584	19,477	33,716	.....	1,227,777	5,360,000	4.37	2,315	848	453	3,616	112
California, Idaho, and Oregon	19,015	13,305	6,525	.....	38,845	181,000	4.66	35	48	58	141	149
Colorado	8,408,613	399,816	253,718	60,613	9,122,760	32,377,000	3.55	8,456	3,450	2,623	14,529	164
Georgia	18,755	373	1,979	12,708	33,815	171,000	2.14	59	26	51	136	183
Illinois	64,174,112	3,371,482	2,057,169	.....	69,602,763	190,986,000	2.74	60,466	25,043	9,922	95,431	152
Indiana	19,116,259	610,620	592,630	.....	20,319,509	52,269,000	2.57	20,472	8,460	3,755	32,687	128
Iowa	3,891,368	521,465	118,559	.....	4,531,392	17,256,800	3.81	7,597	2,815	974	11,386	148
Kansas	3,250,299	111,448	104,894	.....	3,466,641	13,333,300	3.85	5,453	1,538	1,216	8,207	137
Kentucky	30,096,762	802,744	527,257	161,507	31,588,270	85,092,600	2.69	28,737	12,996	8,788	50,521	152
Maryland	1,743,710	56,734	27,296	.....	1,827,740	6,602,000	3.61	2,964	978	726	4,668	120
Michigan	1,058,789	11,354	71,572	.....	1,141,715	5,555,000	4.87	1,346	622	244	2,212	196
Missouri	3,209,496	242,136	99,989	.....	3,551,621	13,915,500	3.92	5,141	1,830	1,584	8,555	166
Montana	2,492,344	115,538	126,076	.....	2,733,958	8,921,600	3.26	2,396	1,064	718	4,178	143
New Mexico	2,326,034	34,754	62,259	30,435	2,453,482	9,585,000	3.91	2,735	1,120	722	4,577	150
North Carolina	20,000	.....	3,438	.....	23,438	135,000	5.76	38	7	15	60	300
North Dakota	700,950	135,550	28,403	.....	864,903	2,329,500	2.69	566	209	289	1,064	194
Ohio	29,788,393	1,559,953	594,243	187	31,942,776	84,686,500	2.65	33,143	11,555	7,087	51,785	134
Oklahoma	3,208,381	25,559	128,683	.....	3,362,623	15,546,000	4.62	5,000	2,425	1,429	8,854	141
Pennsylvania (bituminous)	102,025,340	4,315,590	2,552,372	7,120,640	116,013,942	322,538,300	2.78	119,818	44,404	26,421	190,643	151
South Dakota	450	7,069	34	.....	7,553	21,200	2.81	43	.....	.....	43	129
Tennessee	4,194,364	88,199	123,730	54,033	4,460,326	14,932,000	3.35	6,061	2,500	1,786	10,347	154
Texas	947,589	2,691	22,559	.....	972,839	2,563,600	2.64	1,989	609	294	2,892	139
Utah	3,668,661	74,705	73,365	262,053	4,078,784	13,662,000	3.35	2,450	1,041	931	4,422	151
Virginia	6,818,178	152,729	98,950	422,521	7,492,378	22,947,700	3.06	5,751	4,056	2,115	11,922	166
Washington	2,274,202	59,644	88,585	6,291	2,428,722	9,787,000	4.03	2,241	1,245	848	4,334	159
West Virginia	68,655,196	2,983,061	808,609	340,130	72,786,996	206,661,500	2.84	53,801	30,951	17,098	101,850	149
Wyoming	6,875,284	103,495	221,887	.....	7,200,666	23,358,500	3.24	4,789	2,231	1,464	8,484	167
Total bituminous	382,063,736	16,135,621	9,123,117	8,599,476	415,921,950	1,199,983,600	2.89	399,270	168,019	96,465	663,754	149
Pennsylvania anthracite	77,901,110	2,812,551	9,759,790	.....	90,473,451	452,304,903	5.00	73,977	42,840	42,682	159,499	271
Grand total	459,964,846	18,948,172	18,882,907	8,599,476	506,395,401	1,652,288,600	3.26	473,247	210,859	139,147	823,253	173

Anthracite produced in the United States in 1920 and 1921, by regions.

Region.	Shipments.		Local sales.		Used for power.		Total production.		Men employed.			Average number of days worked.
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.	Underground.	Surface.	Total.	
1920.												
Lehigh:												
Freshly mined coal	9,177,704	$55,316,537	580,169	$1,958,945	1,185,446	$2,298,261	10,943,319	$59,573,743	12,172	6,497	18,669	270
Washery product	722,414	2,993,502	40,430	80,869	14,722	34,331	777,566	3,108,702	.....	290	290	274
Dredge product	39,123	86,153	.....	.....	41	164	39,164	86,317	.....	37	37	216
	9,939,241	58,396,192	620,599	2,039,814	1,200,209	2,332,756	11,760,049	62,768,762	12,172	6,824	18,996	270
Average value per ton	$5.88		$3.29		$1.94		$5.34					
Schuylkill:												
Freshly mined coal	18,628,633	111,309,896	451,326	2,627,580	3,246,184	2,792,189	22,326,143	116,729,665	29,308	15,641	44,949	273
Washery product	1,759,280	6,490,011	28	121	193,543	284,383	1,952,851	6,774,515	.....	1,095	1,095	265
Dredge product	345,515	437,611	258,300	309,903	6,212	8,124	610,027	755,638	.....	280	280	184
	20,733,428	118,237,518	709,654	2,937,604	3,445,939	3,084,696	24,889,021	124,259,818	29,308	17,016	46,324	273
Average value per ton	$5.70		$4.14		$0.90		$4.99					
Wyoming:												
Freshly mined coal	35,371,288	222,628,776	1,234,803	6,401,709	3,312,547	5,539,060	39,918,638	234,569,545	59,004	19,098	78,102	272
Washery product	2,133,820	8,200,962	11,018	42,979	794,010	1,861,713	2,938,848	10,105,654	.....	867	867	240
Dredge product	11,928	20,341	.....	.....	.....	.....	11,928	20,341	.....	9	9	200
	37,517,036	230,850,079	1,245,821	6,444,688	4,106,557	7,400,773	42,869,414	244,695,540	59,004	19,974	78,978	271
Average value per ton	$6.15		$5.17		$1.80		$5.71					
Sullivan County:												
Freshly mined coal	421,058	2,376,826	10,089	57,590	48,806	113,662	479,953	2,528,078	539	237	776	252
Average value per ton	$5.60		$5.71		$2.33		$5.27					
Total freshly mined coal	63,598,683	391,612,035	2,276,387	11,045,824	7,792,983	10,743,172	73,668,053	413,401,031	101,023	41,473	142,496	272
Average value per ton	$6.16		$4.85		$1.38		$5.61					
Total washery product	4,615,514	17,684,475	51,476	123,969	1,002,275	2,180,427	5,669,265	19,988,871	.....	2,252	2,252	257
Average value per ton	$3.83		$2.41		$2.18		$3.53					
Total dredge product	396,566	544,105	258,300	309,903	6,253	8,288	661,119	862,296	.....	326	326	188
Average value per ton	$1.37		$1.20		$1.33		$1.30					
Grand total	68,610,763	409,840,615	2,586,163	11,479,696	8,801,511	12,931,887	79,998,437	434,252,198	101,023	44,051	145,074	271
Average value per ton	$5.97		$4.44		$1.47		$5.43					

Anthracite produced in the United States in 1920 and 1921, by regions—Continued.

Region.	Shipments.		Local sales.		Used for power.		Total production.		Men employed.			Average number of days worked.
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.	Underground.	Surface.	Total.	
1921.												
Lehigh:												
Freshly mined coal	9,092,702	$56,344,295	537,329	$1,905,323	1,117,214	$1,774,374	10,747,245	$60,023,992	13,886	6,738	20,624	270
Washery product	242,944	1,016,075	14,272	25,608	1,398	5,065	258,614	1,046,748	.....	96	96	224
Dredge product	21,599	27,336	.....	.....	150	300	21,749	27,636	.....	7	7	155
	9,357,245	57,387,706	551,601	1,930,931	1,118,762	1,779,739	11,027,608	61,098,376	13,886	6,841	20,727	270
Average value per ton	$6.13		$3.50		$1.59		$5.54					
Schuylkill:												
Freshly mined coal	19,382,865	119,259,110	435,606	2,659,909	3,311,935	2,100,261	23,130,406	124,019,280	33,160	15,566	48,726	278
Washery product	449,390	1,515,108	.....	.....	88,843	122,682	538,233	1,637,790	.....	744	744	86
Dredge product	225,913	220,010	286,725	363,692	4,550	4,631	517,188	588,333	.....	291	291	180
	20,058,168	120,994,228	722,331	3,023,601	3,405,328	2,227,574	24,185,827	126,245,403	33,160	16,601	49,761	274
Average value per ton	$6.03		$4.19		$0.65		$5.22					
Wyoming:												
Freshly mined coal	39,268,163	248,866,892	1,227,457	6,920,174	3,834,466	4,859,113	44,330,086	260,646,179	69,297	18,413	87,710	270
Washery product	616,102	2,232,474	241	506	303,442	394,783	919,785	2,627,763	.....	515	515	144
Dredge product	17,199	33,115	308	1,520	100	50	17,607	34,685	.....	15	15	120
	39,901,464	251,132,481	1,228,006	6,922,200	4,138,008	5,253,946	45,267,478	263,308,627	69,297	18,943	88,240	269
Average value per ton	$6.29		$5.64		$1.27		$5.82					
Sullivan County:												
Freshly mined coal	237,686	1,475,463	9,268	57,474	52,000	119,560	298,954	1,652,497	474	297	771	206
Average value per ton	$6.21		$6.20		$2.30		$5.53					
Total freshly mined coal	67,981,416	425,945,760	2,209,660	11,542,880	8,315,615	8,853,308	78,506,691	446,341,948	116,817	41,014	157,831	272
Total washery product	1,308,436	4,763,657	14,513	26,114	393,683	522,530	1,716,632	5,312,301	.....	1,355	1,355	118
Total dredge product	264,711	280,461	287,033	365,212	4,800	4,981	556,544	650,654	.....	313	313	176
Grand total	69,554,563	430,989,878	2,511,206	11,934,206	8,714,098	9,380,819	80,779,867	452,304,903	116,817	42,682	159,499	271
Average value per ton	$6.20		$4.75		$1.08		$5.60					

Anthracite shipped in 1920 and 1921, by regions and sizes, in long tons.

Size.	Lehigh region.			Schuylkill region.			Wyoming region.			Sullivan County.	Total.	Percentage of total.
	Mines.	Washeries.	Dredges.	Mines.	Washeries.	Dredges.	Mines.	Washeries.	Dredges.	Mines.		
1920.												
Lump	1,024			28,041			4,259				33,324	0.1
Broken	373,471	1,844		928,341			1,972,377	6,584		18,961	3,301,578	4.8
Egg	1,242,426	10,785		2,315,683	6,181		6,294,294	34,237		37,978	9,941,584	14.5
Stove	1,623,253	20,563		3,087,585	4,592		7,514,769	71,057		58,811	12,380,630	18.0
Chestnut	2,265,043	157,492		4,304,752	195,707	17	10,052,270	266,427		85,832	17,327,540	25.2
Pea	956,644	71,822	1,813	1,900,374	212,371	26	2,098,234	163,337	169	52,798	5,457,588	8.0
Buckwheat No. 1	1,328,694	74,570	3,745	3,195,618	451,284	8,463	3,773,327	331,867	366		9,167,934	13.4
Buckwheat No. 2 or rice	642,585	78,657	5,318	1,389,797	422,958	36,301	2,153,301	779,184	11,393		5,519,494	8.0
Buckwheat No. 3 or barley	563,158	301,320	28,247	1,131,456	394,555	164,974	1,089,468	273,139			3,946,317	5.7
Boiler	45,014			272,549	47,394	85,475	263,902	98,029			812,363	1.2
Other [a]	136,392	5,361		74,437	24,238	50,259	155,087	109,959		166,678	722,411	1.1
	9,177,704	722,414	39,123	18,628,633	1,759,280	345,515	35,371,288	2,133,820	11,928	421,058	68,610,763	100.0
1921.												
Lump				9,703			2,627				12,330	
Broken	174,262	1,145		641,957	3,507		1,643,335	68		10,416	2,474,690	3.6
Egg	1,307,612	12,221		2,520,409	5,496		6,361,616	6,990		25,515	10,239,859	14.7
Stove	1,757,426	16,293		3,793,819	4,991		9,035,728	35,344		44,037	14,687,638	21.1
Chestnut	2,358,864	38,244		4,807,884	53,948		11,235,371	76,837		65,534	18,636,682	26.8
Pea	981,552	26,596	865	2,020,455	47,060	28	2,684,236	68,646	1,280	34,661	5,865,379	8.4
Buckwheat No. 1	1,233,111	28,518	1,165	3,347,167	103,958	40,423	4,479,479	113,228	1,960		9,349,009	13.4
Buckwheat No 2 or rice	598,681	29,082		1,151,726	90,587	2,915	2,508,298	134,325			4,515,614	6.5
Buckwheat No. 3 or barley	563,106	89,537	19,569	1,043,122	130,317	40,680	1,128,820	146,368	3,199		3,164,718	4.6
Boiler	15,493	1,308		4,985	21	68,799	147,082	29,748	10,760		278,196	.4
Other [a]	102,595			41,638	9,505	73,068	41,571	4,548		57,523	330,448	.5
	9,092,702	242,944	21,599	19,382,865	449,390	225,913	39,268,163	616,102	17,199	237,686	69,554,563	100.0

[a] Includes quantity reported as culm, buckwheat No. 4, screenings, settlings, silt, mine run, dirt, and slush.

Value of anthracite shipped in 1920 and 1921, by regions and sizes.

1920.

Size.	Lehigh region.						Schuylkill region.					
	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.
Lump	$7,996	$7.81	.....	.....	.....	.....	$196,170	$6.99	.....	.....	.....	.....
Broken	2,639,174	7.07	$12,379	$6.71	.....	.....	7,004,699	7.55	.....	.....	.....	.....
Egg	9,210,337	7.41	77,197	7.16	.....	.....	17,304,675	7.47	$43,102	$6.97	.....	.....
Stove	12,362,601	7.62	154,973	7.54	.....	.....	23,814,766	7.71	34,107	7.43	.....	.....
Chestnut	17,296,056	7.64	1,151,691	7.31	.....	.....	33,388,549	7.76	1,542,871	7.88	$149	$8.76
Pea	5,473,221	5.72	424,316	5.91	$9,189	$5.07	11,021,435	5.80	1,213,887	5.72	132	5.08
Buckwheat No. 1	5,044,994	3.80	284,891	3.82	11,438	3.05	12,240,122	3.83	1,720,094	3.81	20,983	2.48
Buckwheat No. 2 or rice	1,945,220	3.03	237,468	3.02	15,379	2.89	3,679,530	2.65	1,130,020	2.67	59,553	1.64
Buckwheat No. 3 or barley	1,141,959	2.03	643,918	2.14	50,147	1.78	2,052,416	1.81	700,816	1.78	171,670	1.04
Boiler	118,021	2.62	.....	.....	.....	.....	556,889	2.04	93,168	1.97	110,755	1.30
Other	76,958	.56	6,669	1.24	.....	.....	50,645	.68	11,946	.49	74,369	1.48
	55,316,537	6.03	2,993,502	4.15	86,153	2.20	111,309,896	5.98	6,490,011	3.69	437,611	1.27

Size.	Wyoming region.						Sullivan County.		Total.	
	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.	Mines.	Average value.	Total.	Average value.
Lump	$40,051	$9.40	.....	.....	.....	.....	.....	.....	$244,217	$7.33
Broken	13,311,547	6.75	$44,880	$6.81	.....	.....	$158,714	$8.37	23,171,393	7.02
Egg	44,714,391	7.10	267,313	7.81	.....	.....	289,793	7.63	71,906,808	7.23
Stove	55,599,619	7.40	510,065	7.18	.....	.....	444,572	7.56	92,920,703	7.51
Chestnut	74,437,071	7.40	2,174,614	8.16	.....	.....	711,236	8.29	130,702,237	7.54
Pea	11,748,817	5.60	874,794	5.36	$372	$2.20	312,016	5.91	31,078,179	5.69
Buckwheat No. 1	13,899,789	3.68	1,192,886	3.59	821	2.21	.....	.....	34,416,018	3.75
Buckwheat No. 2 or rice	5,644,472	2.62	2,101,038	2.70	19,148	1.68	.....	.....	14,831,828	2.69
Buckwheat No. 3 or barley	2,205,862	2.02	535,827	1.96	.....	.....	.....	.....	7,502,615	1.90
Boiler	672,573	2.55	258,583	2.64	.....	.....	.....	.....	1,809,989	2.23
Other	354,584	2.28	240,962	2.19	.....	.....	440,495	2.64	1,256,628	1.74
	222,628,776	6.29	8,200,962	3.84	20,341	1.71	2,356,826	5.60	409,840,615	5.97

Value of anthracite shipped in 1920 and 1921, by regions and sizes—Continued.

1921.

Size.	Lehigh region.						Schuylkill region.					
	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.
Lump							$72,768	$7.50				
Broken	$1,308,653	$7.51	$8,326	$7.27			4,983,053	7.76	$27,090	$7.72		
Egg	10,042,861	7.68	91,236	7.47			19,234,895	7.63	41,064	7.47		
Stove	13,946,710	7.94	131,046	8.04			29,647,890	7.81	39,915	8.00		
Chestnut	18,557,999	7.87	304,531	7.96			38,074,078	7.92	394,674	7.32		
Pea	5,812,210	5.92	161,178	6.06	$2,890	$3.34	11,710,372	5.80	259,573	5.52	$56	$2.00
Buckwheat No. 1	4,305,755	3.49	101,947	3.57	2,562	2.20	11,508,711	3.44	348,767	3.35	49,244	1.22
Buckwheat No. 2 or rice	1,437,219	2.40	68,509	2.36			2,558,390	2.22	212,845	2.35	3,627	1.24
Buckwheat No. 3 or barley	868,234	1.54	146,143	1.63	21,884	1.12	1,425,757	1.37	184,536	1.42	33,554	.82
Boiler	15,481	1.00	3,159	2.42			12,110	2.43	39	1.86	67,702	.98
Other	49,173	.48					31,086	.75	6,605	.69	65,827	.90
	56,344,295	6.20	1,016,075	4.18	27,336	1.27	119,259,110	6.15	1,515,108	3.37	220,010	.97

Size.	Wyoming region.						Sullivan County.		Total.	
	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.	Mines.	Average value.	Total.	Average value.
Lump	$13,683	$5.21							$86,451	$7.01
Broken	11,839,868	7.20	$553	$8.13			$77,715	$7.46	18,245,258	7.37
Egg	46,329,198	7.28	47,591	6.81			191,176	7.49	75,978,021	7.42
Stove	68,305,209	7.56	262,090	7.42			338,167	7.68	112,671,027	7.67
Chestnut	84,281,697	7.50	548,017	7.13			504,408	7.70	142,665,404	7.66
Pea	15,130,474	5.64	384,487	5.60	$7,040	$5.50	204,683	5.91	33,672,963	5.74
Buckwheat No. 1	15,247,964	3.40	401,797	3.55	4,900	2.50			31,971,647	3.42
Buckwheat No. 2 or rice	5,650,883	2.25	304,732	2.27					10,236,205	2.27
Buckwheat No. 3 or barley	1,665,024	1.48	214,807	1.47	10,339	3.23			4,570,278	1.44
Boiler	336,690	2.29	60,518	2.03	10,836	1.01			506,535	1.82
Other	66,202	1.59	7,882	1.73			159,314	2.77	386,089	1.17
	248,866,892	6.34	2,232,474	3.62	33,115	1.93	1,475,463	6.21	430,989,878	6.20

IMPORTS AND EXPORTS.

Coal imported into the United States, 1917–1921.

Year.	Anthracite.		Bituminous.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	12,530	$46,523	1,448,453	$4,795,110	1,460,983	$4,841,633
1918	37,272	204,385	1,457,073	6,694,081	1,494,345	6,898,466
1919	82,818	522,419	1,011,550	4,950,686	1,094,368	5,473,105
1920	31,748	257,835	1,244,990	6,733,676	1,276,738	6,991,511
1921	8,894	93,103	1,257,589	7,363,945	1,266,483	7,457,048

Coal exported from the United States, 1917–1921.

Year.	Anthracite.		Bituminous.[a]		Total.[a]	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	6,007,306	$30,909,798	23,839,558	$79,502,654	29,846,864	$110,412,452
1918	4,967,808	29,215,689	22,350,730	78,664,856	27,318,538	107,880,545
1919	4,976,598	36,668,131	20,113,536	83,708,842	25,090,134	120,376,973
1920	5,403,749	45,538,100	38,517,084	304,273,241	43,920,833	349,811,341
1921	4,677,368	45,624,555	23,131,166	122,597,038	27,808,534	168,221,593

[a] Exclusive of bunker coal.

COBALT.

PRODUCTION.

The only cobalt ore known to have been produced in the United States in 1921 was a carload of heterogenite (cobalt oxide) mined by Harvey Hardy and associates near Goodsprings, Nev., and about ready to ship at the end of the year. In 1920 cobalt ores were mined only in Missouri, where the Missouri Cobalt Co. recovered 102,410 pounds of cobalt oxide and cobalt hydrate, valued at $262,801, from ore mined on its property near Fredericktown. The company operated only part of the year. In 1919 cobalt ores were mined in Idaho and Missouri. In Idaho the Haynes Stellite Co. produced concentrates carrying approximately 18 per cent of cobalt, and in Missouri the Missouri Cobalt Co. shipped cobalt oxide mined and reduced at its property near Fredericktown. In 1918 cobalt ores were mined only in Idaho, where the Haynes Stellite Co. produced 55 tons of concentrates, carrying 17.74 per cent of cobalt (19,514 pounds), from 4,000 tons of ore.

IMPORTS.

Most of the cobalt used in this country has been imported from Canada, where it is obtained as a by-product from silver ores mined in the Cobalt district.

Cobalt ore, cobalt, zaffer, and oxide imported for consumption in the United States, 1919–1921.

Year.	Ore.		Cobalt.		Zaffer.		Oxide.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1919	17,045	$2,832	60,511	$141,450	.....	.....	131,424	$184,751	208,980	$329,033
1920	13,039	4,794	143,603	326,864	220	$14	202,724	399,605	359,586	731,277
1921	7,657	3,235	38,442	105,539	.....	.....	164,003	342,426	210,102	451,200

COKE.

PRODUCTION.

Coke produced in the United States, 1917–1921.

Year.	By-product coke.				Beehive coke.				Total.	
	Quantity.		Value.		Quantity.		Value.			
	Short tons.	Percentage of total.	Amount.	Percentage of total.	Short tons.	Percentage of total.	Amount.	Percentage of total.	Short tons.	Value.
1917	22,439,280	40.4	$138,643,153	46.5	33,167,548	59.6	$159,599,864	53.5	55,606,828	$298,243,017
1918	25,997,580	46.0	193,018,785	50.5	30,480,792	54.0	189,305,583	49.5	56,478,372	382,324,368
1919	25,137,621	56.9	160,244,768	62.0	19,042,936	43.1	98,094,972	38.0	44,180,557	258,339,740
1920	30,833,951	60.0	313,028,732	63.3	20,511,092	40.0	181,217,522	36.7	51,345,043	494,246,254
1921	19,749,580	78.1	117,506,646	79.6	5,538,042	21.9	30,166,449	20.4	25,287,622	147,673,095

Coke produced in the United States, 1920 and 1921, by States.

State.	1920		1921	
	Short tons.	Value.[a]	Short tons.	Value.[a]
Alabama	4,013,891	$35,259,036	2,534,039	$12,256,085
Colorado	789,499	6,661,534	368,131	3,086,728
Georgia	16,523	197,285	6,943	80,828
Illinois	2,136,793	25,791,092	1,322,178	11,383,808
Indiana	4,553,697	46,994,153	3,091,263	19,007,519
Kentucky	739,577	5,576,205	284,825	1,863,707
Maryland	682,132	3,785,833	292,439	(b)
Massachusetts	488,089	(b)	294,059	(b)
Michigan	1,393,445	15,731,994	777,125	7,050,191
Minnesota	674,801	10,675,352	435,866	4,337,016
Missouri	(c)	(c)	(c)	(c)
New Jersey	725,571	(b)	739,768	(b)
New Mexico	(c)	(c)	(c)	(c)
New York	1,040,192	12,066,227	746,916	5,451,865
Ohio	5,701,819	53,242,029	3,028,423	16,272,453
Pennsylvania	23,638,739	217,666,031	9,769,476	44,111,831
Rhode Island	(c)	(c)	(c)	(c)
Tennessee	301,708	2,928,557	85,728	459,469
Utah	(c)	(c)	(c)	(c)
Virginia	1,027,788	9,106,202	280,476	2,029,652
Washington	59,395	627,451	27,260	194,510
West Virginia	1,828,336	16,874,508	397,892	2,253,044
Wisconsin	(c)	(c)	(c)	(c)
Combined States	1,533,057	16,809,111	804,815	7,550,873
Undistributed		14,252,663		10,283,516
	51,345,043	494,246,254	25,287,622	147,673,095

[a] Includes estimate by Geological Survey in 1920 and operators' statements in 1921 of value for that portion of product not sold (such as coke consumed by producer in associated iron furnaces).
[b] Included under "Undistributed."
[c] Included under "Combined States."

By-product coke produced and sold or used by the producer in the United States, 1921, by States and kinds.

State.	Produced (short tons).		Sold.								Used by producer (short tons).	
	Coke.	Screenings and breeze.	Furnace.		Foundry.		Domestic and other.		Screenings and breeze.		Coke.	Screenings and breeze.
			Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.		
Alabama	2,401,127	155,568	294,818	$1,613,161	12,954	$108,157	41,493	$182,413	14,440	$31,768	1,726,667	127,517
Colorado	286,755	23,492	18,137	(a)							268,739	23,140
Illinois	1,322,178	123,061	200,755	1,945,854	78,686	824,912	250,224	2,300,926	35,725	104,821	663,074	80,739
Indiana	3,091,263	254,056	4,180	35,890	80,110	759,481	134,082	1,051,777	10,578	18,177	2,684,908	207,208
Kentucky	185,383	10,066	113,942	600,095	40,000	308,836	29,889	180,133	10,179	7,128		
Maryland	292,439	19,034	102,358	(a)					752	(a)	124,603	21,330
Massachusetts	294,059	23,984	5,684	(a)	191,306	(a)	83,678	(a)	23,546	(a)		
Michigan	777,125	58,848	24,392	187,663	133,114	1,407,347	356,553	3,047,361	34,861	61,770	221,459	46,409
Minnesota	435,866	42,329	3,610	31,235	36,214	441,004	96,538	975,746	1,782	3,845	154,649	39,232
New Jersey	739,768	60,621	155,716	(a)	44,219	(a)	232,229	(a)	15,227	(a)	28,904	45,772
New York	746,916	54,868	311,093	2,403,499	9,313	70,629	64,285	628,419	785	5,845	336,280	74,924
Ohio	2,966,273	327,672	419,176	2,188,509	7,045	46,454	67,806	329,908	35,772	26,117	2,503,008	275,971
Pennsylvania	5,303,371	587,287	747,216	4,550,399	76	576	46,604	208,940	7,103	10,404	4,542,614	453,114
Tennessee	57,723	958	5,795	28,390	22,208	125,355	3,536	16,299	999	3,296		
Washington	23,765	6,594					704	4,928			19,667	6,595
West Virginia	188,355	15,578	56,797	255,447			11,254	52,994	153	72	109,579	15,579
Missouri, Rhode Island, Wisconsin	637,214	67,094	129,649	1,225,361	81,146	905,657	261,036	2,369,352	13,965	34,287	86,245	55,089
Undistributed				2,137,491		2,664,373		2,459,969		166,579		
	19,749,580	1,831,110	2,593,318	17,202,994	736,391	7,662,781	1,679,911	13,809,165	205,867	474,109	13,470,396	1,472,619

a Included under "Undistributed."

Beehive coke produced and sold or used by the producer in the United States, 1921, by States and kinds.

State.	Produced (short tons).		Sold.								Used by producer (short tons).	
	Coke	Screenings and breeze.[a]	Furnace.		Foundry.		Domestic and other.		Screenings and breeze.		Coke.	Screenings and breeze.
			Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.		
Alabama	132,912	6,916	.....	.....	63,133	$411,471	.....	.....	.....	.....	69,586	4,850
Colorado	81,376	1,137	669	(b)	24,078	(b)	953	(b)	519	(b)	56,358	149
Georgia	6,943	345	.....	.....	6,943	80,828	.....	.....	300	$60	.....	.....
Kentucky	99,442	.....	100,509	$753,621	.....	.....	.....	.....	.....	.....	.....	.....
Ohio	62,150	2,200	.....	.....	.....	.....	24	(b)	1,320	(b)	62,126	880
Pennsylvania	4,466,105	41,162	3,362,526	16,526,871	758,341	4,093,408	49,455	$214,152	3,842	7,755	275,834	4,641
Tennessee	28,005	.....	10,406	72,738	11,060	63,306	.....	.....	.....	.....	6,403	.....
Virginia	280,476	2,138	191,363	1,407,393	77,161	527,150	.....	.....	2,138	11,821	13,034	.....
Washington	3,495	.....	2,544	23,795	951	10,777	.....	.....	.....	.....	.....	.....
West Virginia	209,537	104	127,624	791,441	68,104	504,614	2,481	16,795	104	455	12,116	.....
New Mexico Utah	167,601	4,265	162,068	1,396,947	1,572	13,121	3,961	33,664	4,687	14,248	24	.....
Undistributed	.....	.....	.....	6,580	.....	227,924	.....	7,801	.....	5,193	.....	.....
	5,538,042	58,267	3,957,709	20,979,386	1,011,343	5,932,599	56,874	272,412	12,910	39,532	495,481	10,520

[a] Figures here given are those reported by operators but are far short of the total quantity produced, for at many beehive plants the fines have no value.
[b] Included under "Undistributed."

Beehive and by-product coke and pig iron produced in the United States in 1921, by months.

Month.	Coke (short tons).[a]		Pig iron (long tons).[a]
	Beehive.	By-product.	
January	1,088,000	2,259,000	2,416,000
February	870,000	1,872,000	1,937,000
March	578,000	1,757,000	1,596,000
April	330,000	1,506,000	1,193,000
May	302,000	1,577,000	1,221,000
June	233,000	1,396,000	1,065,000
July	181,000	1,286,000	865,000
August	250,000	1,371,000	954,000
September	291,000	1,411,000	986,000
October	418,000	1,720,000	1,247,000
November	480,000	1,751,000	1,415,000
December	517,000	1,844,000	1,649,000
Total, 1921	5,538,000	19,750,000	16,544,000
Monthly average, 1920	1,709,000	2,569,000	3,077,000

[a] 1921: According to Iron Age; 1920: According to American Iron and Steel Institute.

IMPORTS AND EXPORTS.

Coke imported into and exported from the United States, 1917–1921.

Year.	Imports for consumption.		Exports.	
	Short tons.	Value.	Short tons.	Value.
1917	24,872	$146,451	1,409,320	$8,543,746
1918	30,168	221,880	1,687,824	11,861,408
1919	16,486	140,653	716,956	5,128,119
1920	41,143	403,175	919,802	9,993,665
1921	30,990	336,394	306,755	2,760,939

COKE-OVEN BY-PRODUCTS.

By-products from coke-oven operations in the United States, 1920–1921.

Product.	Produced.	Sold.		
		Quantity.	Value.	Average value.
1920.				
Tar.....gallons..	360,664,124	174,363,696	$6,378,040	$0.037
Ammonia:				
Sulphate.....pounds..	675,816,486	626,013,975	27,110,260	.043
Ammonia liquor (NH_3 content).....do....	65,777,259	62,076,772	8,585,173	.138
Sulphate equivalent.....do....	(938,925,522)	(874,321,063)	35,695,433	.041
Gas:				
Distributed through city mains.....M cu. ft..	[a]476,485,744	53,220,824	15,716,888	.295
Used in steel or affiliated plant.....do....		151,764,807	14,301,095	.094
Used under boilers, etc.....do....		25,430,288	2,216,335	.087
			32,234,318	.140
Light oil and derivatives:				
Crude light oil.....gallons..	[b] 109,709,915	1,067,045	126,158	.118
Benzol {crude.....do....	8,747,572	1,510,420	401,296	.266
Benzol {refined.....do....	16,977,556	15,720,356	4,096,527	.260
Motor fuel (or motor benzol).....do....	57,645,462	55,764,265	12,644,931	.227
Toluol {crude.....do....	287,142			
Toluol {refined.....do....	2,710,649	2,470,364	740,722	.300
Solvent naphtha.....do....	5,678,525	4,695,464	851,048	.181
			18,860,682	
Naphthalene {crude.....pounds..	11,246,807	11,507,703	307,999	.027
Naphthalene {refined.....do....	2,921,282	2,941,059	179,975	.061
			487,974	
Other products.....	.....	.....	36,317	.....
	.....	.....	[c] 93,692,764	.....
1921.				
Tar.....gallons..	253,051,649	135,293,047	5,645,309	.042
Ammonia:				
Sulphate.....pounds..	528,638,763	530,041,716	13,100,703	.025
Ammonia liquor (NH_3 content).....do....	31,899,398	35,102,561	3,515,416	.100
Other forms (NH_3 content).....do....	191,162	53,993	10,135	.188
Sulphate equivalent.....do....	(657,001,003)	(670,667,932)	16,626,254	.025
Gas:				
Distributed through city mains.....M cu. ft..	[a]310,188,713	43,826,172	14,249,961	.325
Used in steel or affiliated plant.....do....		98,352,049	10,593,204	.108
Used under boilers, etc.....do....		12,122,777	1,120,087	.092
			25,963,252	.168
Light oil and derivatives:				
Crude light oil.....gallons..	[b] 76,917,269	2,433,078	240,111	.099
Benzol {crude.....do....	1,494,329	1,536,312	343,463	.224
Benzol {refined.....do....	4,912,131	5,302,709	1,268,258	.239
Motor fuel (or motor benzol).....do....	48,052,882	50,022,573	8,966,686	.179
Toluol {crude.....do....	26,529	26,529	4,410	.166
Toluol {refined.....do....	942,982	808,964	228,968	.283
Solvent naphtha.....do....	3,822,776	2,881,656	510,509	.177
Other miscellaneous products.....do....	590,173	291,635	12,310	.042
			11,574,715	.183
Naphthalene {crude.....pounds..	2,827,756	1,652,466	40,659	.025
Naphthalene {refined.....do....	115,229	331,057	18,676	.056
			59,335	.030
Other products.....	.....	.....	121,813	.....
	.....	.....	[c] 59,990,678	.....

[a] Inclusive of gas wasted and gas used for heating retorts.
[b] Of the crude light oil produced, 106,564,417 gallons in 1920 and 75,760,334 gallons in 1921 were refined by the producer to make the derived products listed.
[c] Exclusive of value of coke breeze.

COPPER.

SUMMARY OF STATISTICS.

Summary of statistics of the copper industry in the United States, 1918–1921.

	1918	1919	1920	1921
Production of copper:				
Smelter output.....pounds..	1,908,533,595	1,286,419,329	1,209,061,040	505,586,098
Mine production.....do....	1,910,022,841	1,212,334,041	1,224,550,151	466,190,853
Refinery production of new copper—				
Electrolytic.....pounds..	1,560,327,422	1,233,994,324	1,010,240,867	506,532,984
Lake.....do....	231,096,158	177,594,135	153,483,952	100,918,001
Casting and pig.....do....	91,450,611	21,897,336	18,698,421	1,963,271
Total domestic.....do....	1,882,874,191	1,433,485,795	1,182,423,240	609,414,256
Total domestic and foreign....do....	2,432,385,290	1,805,306,801	1,634,908,644	1,020,027,096
Total new and old copper.....do....	3,138,000,000	2,380,000,000	2,260,000,000	1,455,000,000
Copper ore produced.....short tons..	62,289,069	36,121,622	36,765,370	13,396,382
Average yield of copper.....per cent..	1.51	1.65	1.63	1.70
Average price per pound.....cents..	24.7	18.6	18.4	12.9
Average cost per pound.....do....	14.49	15.25	14.94	(a)
Imports (unmanufactured).....pounds...	575,805,115	429,387,594	485,670,691	350,472,611
Exports of metallic copper [b].....do....	744,243,481	515,595,019	623,158,489	628,415,714
Stocks at end of year:				
Blister and materials in solution .....pounds..	562,600,000	273,000,000	465,000,000	283,000,000
Refined copper.....do....	180,000,000	631,000,000	659,000,000	459,000,000
Withdrawn from total supply on domestic account:				
Total new copper.....pounds..	1,661,669,576	914,471,572	1,053,838,558	610,988,744
Total new and old copper.....do....	2,367,000,000	1,489,000,000	1,679,000,000	1,046,000,000
World's production.....do....	3,148,499,000	(a)	(a)	(a)
Value of production in the United States....	$471,408,000	$239,274,000	$222,467,000	$65,221,000

[a] Figures not yet available.
[b] Total exports of copper, exclusive of ore, concentrates, and composition metal.

PRODUCTION.

Copper produced in the United States from domestic ores, 1918–1921.

[Smelter output, in pounds fine.]

State.	1918	1919	1920	1921
Alaska	67,081,648	56,534,992	66,093,924	76,808,114
Arizona	769,521,729	536,515,368	552,988,731	155,165,656
California	44,150,761	23,548,698	11,822,028	15,906,883
Colorado	7,591,570	4,892,558	4,282,616	6,592,598
Georgia	397,078	8,306	3,663	.....
Idaho	5,836,795	3,966,655	1,922,116	1,971,623
Maine	501,169	376,186	.....	3
Michigan	231,096,158	177,594,135	153,483,952	100,918,001
Missouri	232,073	588,570	533,368	137,591
Montana	326,426,761	176,289,873	177,743,747	49,471,206
Nevada	106,266,603	64,683,734	55,580,322	15,129,116
New Mexico	96,559,580	60,377,320	52,159,751	18,076,909
North Carolina	79,200	3,334	.....	.....
Oregon	2,630,499	2,808,017	2,529,311	274,934
Pennsylvania	34,500	.....	618,361	.....
South Carolina	.....	2,297	.....	.....
South Dakota	.....	8,631	2,190	.....
Tennessee	15,053,568	15,629,454	16,727,803	15,084,294
Texas	13,851	2,153	14,217	587
Utah	230,964,908	143,836,304	110,357,748	45,831,959
Vermont	896,630	582,561	.....	.....
Virginia	1,248	.....	.....	.....
Washington	2,330,568	2,552,134	2,125,586	598,658
Wyoming	866,698	150,051	24,256	9,830
Undistributed	.....	15,467,998	47,350	3,608,136
	1,908,533,595	1,286,419,329	1,209,061,040	505,586,098

Primary and secondary copper produced by regular refining plants in the United States and imported, 1918–1921, in pounds.

	1918	1919	1920	1921
Primary:				
Domestic: [a]				
Electrolytic	1,560,327,422	1,233,994,324	1,010,240,867	506,532,984
Lake	231,096,158	177,594,135	153,483,952	100,918,001
Casting	15,284,635	18,223,145	13,905,114	1,740,393
Pig and best select	76,165,976	3,674,191	4,793,307	222,878
	1,882,874,191	1,433,485,795	1,182,423,240	609,414,256
Foreign: [a]				
Electrolytic	[b] 492,181,364	[b] 370,558,779	[b] 450,194,958	[b] 405,337,490
Casting and best select	57,329,735	1,262,227	2,290,446	5,275,350
	2,432,385,290	1,805,306,801	1,634,908,644	1,020,027,096
Secondary:				
Electrolytic	34,674,062	32,408,548	32,856,549	82,017,382
Casting	9,018,049	38,876,481	49,130,510	24,467,951
	43,692,111	71,285,029	81,987,059	106,485,333
Total output	2,476,077,401	1,876,591,830	1,716,895,703	1,126,512,429

[a] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.
[b] Includes refined copper imported.

In addition to their output of metallic copper the regular refining companies produced in 1921 bluestone having a copper content of 6,646,000 pounds, as compared with 7,823,000 pounds in 1920.

STOCKS.

Stocks of refined copper in the United States, Jan. 1, 1918–1922.

	Pounds.
Jan. 1, 1918	114,000,000
Jan. 1, 1919	180,000,000
Jan. 1, 1920	631,000,000
Jan. 1, 1921	659,000,000
Jan. 1, 1922	459,000,000
Decrease in 1921	200,000,000

In addition to the stocks of refined copper on hand January 1, 1922, 283,000,000 pounds of blister copper and materials in process of refining was reported as at smelters in the United States, in transit from smelters to refiners, and at refineries, against 465,000,000 pounds on January 1, 1921.

CONSUMPTION.

New refined copper withdrawn from total year's supply on domestic account in the United States, 1918–1921, in pounds.

	1918	1919	1920	1921
Total supply of new copper	2,432,385,290	1,805,306,801	1,634,908,644	1,020,027,096
Stocks at beginning of year	114,000,000	180,000,000	631,000,000	659,000,000
Total available supply	2,546,385,290	1,985,306,801	2,265,908,644	1,679,027,096
Copper exported [a]	704,715,714	439,835,229	553,070,086	609,038,352
Stocks at end of year	180,000,000	631,000,000	659,000,000	459,000,000
Total withdrawn from supply	884,715,714	1,070,835,229	1,212,070,086	1,068,038,352
Withdrawn on domestic account [b]	1,661,669,576	914,471,572	1,053,838,558	610,988,744

[a] Includes unrefined black blister and converter copper (bars, pigs, and other forms) and refined in ingots, bars, rods, or other forms.
[b] Formerly called "Apparent domestic consumption."

IMPORTS AND EXPORTS.

Copper imported into the United States, 1920 and 1921, in pounds.

Country.	Ore (copper content).	Concentrates (copper content).	Matte and regulus (copper content).	Unrefined black copper and copper in bars, pigs, or other forms.	Refined in bars, plates, rods, or other forms.	Old and clippings for remanufacture.	Composition metal, copper chief value.
1920.							
United Kingdom	1,256,948	.....	71,982	5,939,811	1,437,027	4,830,953	2,148,843
France	41,842	.....	76,109	3,073,425	3,258,043	4,822,375	54,092
Germany	.....	.....	617,940	130,957	60	806,041	566,625
Spain	2,123,594	.....	.....	.....	1,194,975	.....	.....
Canada	22,022,211	2,922,633	3,611,518	26,287,350	750,916	883,614	132,255
Mexico	883,716	25,931,336	7,361,140	72,670,790	.....	5,648	.....
Cuba	7,786,690	10,659,959	.....	.....	.....	61,387	.....
Chile	9,668,396	4,559,655	4,282,856	46,289,793	101,000,138	6,722	23,850
Peru	1,064,501	148,401	863,328	82,509,806	.....	.....	.....
Japan	.....	.....	.....	.....	.....	.....	.....
Other countries	7,197,393	2,575,606	709,301	7,794,392	1,102,139	141,627	1,309,982
	52,045,291	46,797,590	17,594,174	244,696,324	108,743,298	11,558,367	4,235,647
1921.							
United Kingdom	347,506	.....	26,400	3,721,557	12,404	1,216,687	484,151
France	647,591	.....	209,755	2,870,093	3,785,138	113,363	90,916
Germany	2,693,084	.....	3,844,157	5,207,032	95,032	60,345	294,653
Spain	4,475,091	.....	688,905	7,000	.....	220,792	.....
Canada	2,495,612	723,271	402,385	22,073,731	80,477	3,715,472	.....
Mexico	439,539	10,104,379	3,866,319	16,450,113	51,581	419	.....
Cuba	7,293,930	10,662,517	.....	.....	.....	84,661	.....
Bolivia	1,380,182	.....	.....	.....	.....	.....	.....
Chile	29,630,105	8,821,689	3,408,973	39,242,226	62,312,518	.....	.....
Peru	2,928,806	450,319	740,782	72,016,068	.....	.....	.....
Venezuela	1,383,377	.....	173,665	.....	.....	8,676	.....
Australia	.....	.....	.....	4,490,799	.....	.....	.....
Br. South Africa	1,256,602	.....	1,200,348	.....	460,852	.....	.....
Portuguese Africa	309,344	.....	.....	4,890,520	2,364,026	.....	.....
Other countries	1,397,179	12,171	785,937	766,140	87,253	286,481	111,515
	56,677,948	30,774,346	15,347,626	171,735,279	69,249,281	5,706,896	981,235

Copper exported from the United States, 1919–1921, in pounds.

	1919	1920	1921
Ore (copper content)	507,846	248,712	299,150
Concentrates, matte, and regulus (copper content)	160,821	192,194	60,970
Unrefined black blister and converter copper (bars, pigs, and other forms)	1,674,411	1,843,293	150,313
Refined ingots, bars, rods,[a] or other forms	438,160,818	551,226,793	596,117,247
Rods	(b)	(b)	[b] 12,770,792
Composition metal, copper chief value	364,089	454,306	28,916
Old and scrap	449,804	577,319	615,946
Pipes and tubes	5,993,959	4,899,223	2,248,503
Plates and sheets	13,764,425	22,799,148	5,105,916
Wire	55,551,602	41,812,713	11,406,997
	516,627,775	624,053,701	628,804,750

[a] Rods separately classified after July 1, 1921.
[b] Rods included under "Refined ingots, bars, rods, or other forms" prior to July 1, 1921, when separate classification was made.

CORUNDUM.

[See Abrasive materials.]

CRYOLITE.

PRODUCTION.

No natural cryolite is produced in the United States, the entire supply used in this country being imported from Greenland.

IMPORTS.

Cryolite imported and entered for consumption in the United States, 1916–1921.

Year.	Long tons.	Value.	Average value.	Year.	Long tons.	Value.	Average value.
1916	3,857	$165,222	$42.84	1919	2,131	$106,956	$50.19
1917	4,383	218,500	49.86	1920	3,864	193,638	50.11
1918	1,950	97,500	50.00	1921	3,460	295,186	85.31

DIATOMACEOUS (INFUSORIAL) EARTH.

[See Abrasive materials.]

EMERY.

[See Abrasive materials.]

FELDSPAR.

PRODUCTION.

Crude feldspar produced and sold in the United States, 1916–1921.

Year.	Long tons.	Value.	Year.	Long tons.	Value.
1916	118,465	$404,689	1919	63,441	$347,992
1917	126,715	474,767	1920	135,551	851,123
1918	88,498	429,989	1921	91,865	617,652

Feldspar produced and sold in Canada, 1916–1921.[a]

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	19,488	$71,407	1919	14,679	$86,231
1917	19,462	89,826	1920	37,873	280,895
1918	18,782	112,728	1921	30,540	223,000

[a] Report on mineral production of Canada, Canada Dept. Mines.

IMPORTS AND EXPORTS.

The United States imports nearly the whole of the Canadian production of feldspar and none from other countries. Imports and exports are not specifically shown by the Bureau of Foreign and Domestic Commerce.

FERROALLOYS.

PRODUCTION.[a]

Ferroalloys of domestic manufacture shipped in the United States, 1917–1921, in long tons.[a]

Year.	Ferro-manganese.	Spiegel-eisen.	Other varieties.	Total quantity.	Total value.
1917	260,225	189,241	184,555	634,021	$83,731,724
1918	306,076	263,861	180,931	750,868	115,433,943
1919	198,255	90,855	130,528	419,638	53,730,964
1920	276,594	103,672	232,542	612,808	77,519,367
1921	111,374	69,230	68,023	248,627	21,697,785

[a] The figures for 1917 and 1918 fall short of the actual production of the United States, as the output of certain electrically produced ferroalloys is not available for publication by the Geological Survey.

Ferroalloys of domestic manufacture shipped in the United States in 1920 and 1921.

Variety of alloy.	1920		1921	
	Long tons.	Value.	Long tons.	Value.
Ferromanganese [a]	276,594	$41,840,690	111,374	$13,654,800
Spiegeleisen	103,672	5,289,049	[b] 69,230	[b] 2,838,692
Ferrosilicon (7 per cent or more silicon)	193,580	11,634,650	55,099	2,548,827
Ferromolybdenum	21	47,873	19	43,866
Ferrotungsten	1,084	1,623,710	195	193,914
Other varieties [c]	37,857	17,083,395	12,710	2,417,686
	612,808	77,519,367	248,627	21,697,785

[a] Includes small quantity of silico-manganese.
[b] Includes small quantity of silico-spiegel.
[c] 1920: Ferrocerium, ferrochromium, ferrophosphorus, ferrotantalum-columbium, ferrotitanium, ferrouranium, ferrovanadium, ferrozirconium; 1921: Ferrocarbide, ferrocerium, ferrochromium, ferrophosphorus, ferrotantalum-columbium, ferrotitanium, ferrovanadium, ferrozirconium, zirconium-ferrosilicon.

IMPORTS AND EXPORTS.

Ferroalloys imported for consumption in the United States, 1919–1921.

Variety of alloy.	1919		1920		1921	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
Chrome or chromium and ferrochromium	414	$100,404	1,751	$428,619	452	$106,669
Ferrophosphorus	176	13,388	6	780	5	132
Ferrosilicon	10,445	629,362	13,909	719,446	7,858	388,420
Molybdenum and ferromolybdenum	46	40,759	.....	.....	(a)	349
Titanium and ferrotitanium	5	3,317	1	713	2	1,299
Tungsten and ferrotungsten	177	287,981	892	1,180,829	226	180,371
Ferrovanadium	5	24,923	4	14,331	.....	.....
Ferromanganese	33,022	4,283,541	59,254	7,775,278	9,077	888,419
Spiegeleisen	27	1,018	5,234	277,900	307	10,472
	44,317	5,384,693	81,051	10,397,896	17,927	1,576,131

[a] 345 pounds.

Ferromanganese, ferrosilicon, tungsten and ferrotungsten, and ferrovanadium exported from the United States, 1919–1921.

Variety of alloy.	1919		1920		1921	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
Ferromanganese	2,999	$445,840	3,454	$642,570	690	$100,474
Ferrosilicon	1,544	145,310	632	41,057	368	20,204
Tungsten and ferrotungsten	17	113,276	2	5,913	.....	.....
Ferrovanadium	29	95,560	173	705,385	98	424,886

PRICES.

Prices per ton of ferromanganese and spiegeleisen in the United States, 1919–1921, by months.[a]

Month.	Ferromanganese [b] (delivered at Pittsburgh).			Spiegeleisen [c] (at producer's furnace).		
	1919	1920	1921	1919	1920	1921
January	[b] $212.50	$146.00	$101.00	[c] $67.50	$46.60	$46.25
February	165.00	160.00	96.85	[c] 52.50	57.60	37.75
March	134.00	172.00	89.00	[c] 42.50	60.40	34.20
April	113.75	200.00	87.50	[c] 34.50	66.85	32.00
May	110.00	200.00	83.00	[c] 31.35	75.00	31.75
June	111.75	198.00	76.50	[c] 27.50	75.00	29.60
July	111.00	190.00	75.00	34.00	75.00	27.50
August	110.00	193.75	70.75	34.00	79.35	26.20
September	105.00	172.40	64.75	34.00	82.00	25.25
October	110.00	156.40	61.65	34.00	80.00	24.85
November	110.00	153.00	60.00	34.00	74.35	25.00
December	121.00	120.00	60.00	39.00	64.40	25.00

[a] Iron Trade Review.
[b] Price for January, 1919, based on 70 per cent ferromanganese. All other prices based on 80 per cent.
[c] Prices from January to June, 1919, inclusive, based on 16 per cent spiegeleisen. All other prices based on 20 per cent metal.

FLUORSPAR.

SUPPLY.

Supplies of fluorspar in the United States, 1917–1921.

Year.	Sales of domestic spar.		Imports for consumption.		Apparent consumption.[a]	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	218,828	$2,287,722	13,616	$114,598	232,444	$2,402,320
1918	263,817	5,465,481	12,572	169,364	276,389	5,634,845
1919	138,290	3,525,574	6,943	107,631	145,233	3,633,205
1920	186,778	4,718,547	24,612	265,630	[a] 211,390	4,984,177
1921	34,960	724,094	6,229	69,306	41,189	793,400

[a] No exports have been reported by Bureau of Foreign and Domestic Commerce. Producers reported 2,764 tons exported in 1920.

PRODUCTION.

Fluorspar shipped from mines in the United States, 1920 and 1921, by States.

State.	1920			1921		
	Short tons.	Value.	Average value.	Short tons.	Value.	Average value.
Illinois	120,299	$3,096,767	$25.74	12,477	$315,767	$25.31
Kentucky	46,091	1,246,942	27.05	15,266	294,513	19.29
Nevada	532					
New Hampshire	202	22,070	18.66	567	13,721	24.20
Utah	268					
Arizona	181					
Colorado	12,852	251,308	19.55	3,143	39,907	12.70
New Mexico	6,353	101,460	15.97	3,507	60,186	17.16
	186,778	4,718,547	25.26	34,960	724,094	20.71

FULLER'S EARTH.

PRODUCTION.

Domestic fuller's earth marketed in the United States, 1916–1921.

Year.	Number of operators.	Short tons.	Value.	Average value.	Year.	Number of operators.	Short tons.	Value.	Average value.
1916	10	67,822	$706,951	$10.42	1919	10	106,145	$1,998,829	$18.83
1917	11	72,567	772,087	10.64	1920	12	128,487	2,506,189	19.51
1918	14	84,468	1,146,354	13.57	1921	12	105,609	1,973,848	18.69

IMPORTS AND EXPORTS.

Fuller's earth imported and entered for consumption in the United States, 1916–1921.

Year.	Short tons.	Value.	Average value.	Year.	Short tons.	Value.	Average value.
1916	16,801	$139,664	$8.31	1919	13,873	$189,711	$13.67
1917	16,994	176,417	10.38	1920	19,235	221,893	11.54
1918	12,607	165,535	13.13	1921	9,744	119,415	12.26

Exports of fuller's earth are not reported separately.

GARNET (ABRASIVE).

[See Abrasive materials.]

GAS (NATURAL).

Natural gas produced and consumed in the United States, 1916–1921.

Year.	M cubic feet.	Value.	Year.	M cubic feet.	Value.
1916	753,170,253	$120,227,468	1919	745,916,000	$160,888,000
1917	795,110,376	142,089,334	1920	798,210,000	196,194,000
1918	721,000,959	153,553,560	1921	662,052,000	174,617,000

GASOLINE FROM NATURAL GAS.

Natural-gas gasoline produced in the United States, 1917–1921.

Year.	Number of operators.	Number of plants.	Gasoline produced.			Gas treated (estimated).		
			Gallons.	Value.	Average value.	M cubic feet.	Value.[a]	Average yield of gasoline per M cubic feet (gallon).
1917	[b] 750	886	217,884,104	$40,188,956	18.4	429,288,000	$34,343,000	0.51
1918	503	1,004	282,535,550	50,363,535	17.8	449,109,000	40,420,000	.63
1919	611	1,191	351,535,026	64,196,763	18.3	480,404,000	41,315,000	.73
1920	576	1,154	384,743,922	71,788,122	18.7	496,431,000	41,700,000	.78
1921	458	1,056	449,934,402	61,815,258	13.7	479,618,000	41,500,000	.94

[a] The value of the gas is based on sales to gasoline producers, not on sales for domestic or industrial purposes.

[b] Figures for number of operators in 1917 are not comparable with those for later years as the method of listing has been changed.

Natural-gas gasoline produced in the United States in 1920 and 1921, by States.

State.	1920		1921	
	Gallons.	Value.	Gallons.	Value.
California	48,207,976	$8,323,819	58,220,498	$9,874,594
Illinois	6,054,916	1,307,980	7,536,073	1,101,227
Kansas	4,330,748	828,887	3,587,329	565,408
Kentucky	4,497,320	1,071,628	4,241,938	834,983
Louisiana	10,609,629	1,712,613	15,340,374	1,812,268
New York	411,078	75,576	366,240	52,108
Ohio	10,015,638	2,194,558	9,099,897	1,546,551
Oklahoma	178,856,929	31,334,493	185,340,742	22,066,014
Pennsylvania	21,151,135	4,382,380	19,856,373	3,354,233
Texas	32,956,028	5,770,809	77,141,201	9,118,420
West Virginia	58,941,488	13,049,551	54,646,053	9,889,861
Wyoming	8,711,037	1,735,828	14,557,684	1,599,591
	384,743,922	71,788,122	449,934,402	61,815,258

GEMS AND PRECIOUS STONES.

PRODUCTION.

Value of precious stones produced in the United States, 1916–1921.

Variety.	1916	1917	1918	1919	1920	1921
Agalmatolite	.....	.....	.....	.....	(a)	.....
Andalusite	.....	(a)	(a)	.....	.....	$10
Beryl	$2,031	$2,178	$1,906	(a)	$3,440	1,090
Calamine	.....	.....	(a)	.....	.....	.....
Chlorastrolite	(a)	45	146	$53	(a)	100
Copper-ore gems	1,713	2,857	2,299	(a)	(a)	8,775
Corundum (sapphire)	99,180	54,204	42,414	40,304	214,705	482,745
Datolite	(a)	(a)	(a)	(a)	(a)	.....
Diamond	2,680	4,175	1,910	(a)	(a)	(b)
Epidote	(a)	(a)	(a)	.....	(a)	.....
Feldspar	305	(a)	(a)	(a)	520	155
Fluorite	.....	.....	(a)	.....	.....	.....
Fossil coral	(a)	(a)	.....	(a)	.....	200
Garnet	1,542	624	1,277	1,630	331	606
Hematite	(a)	(a)	138	(a)	45	.....

[a] Included under "Undistributed." [b] No data available.

Value of precious stones produced in the United States, 1916–1921—Continued.

Variety.	1916	1917	1918	1919	1920	1921
Iceland spar	(a)	(a)	(a)	(a)	$398	(a)
Jet				(a)	(a)	$460
Kyanite	(a)					
Lapis lazuli		(a)	(a)	(a)		
Lazulite	(a)					
Mariposite			(a)			
Meerschaum (sepiolite)	(a)	(a)	(a)	(a)		
Obsidian	$134	(a)	(a)		40	67
Olivine	455	$458	$1,018		100	
Opal	1,838	805	6,304	(a)	(a)	336
Phenacite		(a)	(a)			
Pyrite	2,075	(a)	(a)		(a)	
Quartz	25,707	28,273	15,211	$17,632	14,676	11,114
Rhodonite	(a)	512	515	160	(a)	275
Rutile	(a)	(a)				
Satin spar (gypsum)			(a)			
Serpentine	(a)					
Smithsonite		(a)				(a)
Spinel				(a)	(a)	
Spodumene	(a)	(a)	281	(a)		
Staurolite	(a)	(a)	(a)		(a)	
Thomsonite	47	(a)	(a)	(a)	10	10
Topaz	1,005	230	907	210	767	(a)
Tourmaline	59,807	12,452	6,206	17,700	4,869	1,450
Turquoise	21,811	14,171	20,667	22,750	16,865	6,272
Variscite	3,140	2,350	753	925	(a)	560
Vesuvianite	(a)	2,765	320			
Willemite		(a)	(a)			
Zircon					144	
Zoisite		(a)	(a)			
Undistributed	3,323	4,913	4,251	10,399	8,295	4,055
	217,793	131,012	106,523	111,763	265,205	[b] 518,280

[a] Included under "Undistributed."
[b] Production of diamonds in Arkansas not reported.

IMPORTS AND EXPORTS.

Value of diamonds and other precious stones imported and entered for consumption in the United States, 1917–1921.

Year.	Diamonds.				Other stones not set.	Total, excluding pearls.	Pearl
	Glazier's.	Dust and bort.	Rough or uncut.	Cut but not set.			
1917	$1,098,102	$349,746	$13,092,855	$18,421,838	$1,883,810	$34,846,351	$4,947,509
1918	718,397	475,870	12,636,024	7,734,150	1,102,398	22,666,839	765,929
1919	984,381	1,420,442	20,306,758	64,085,610	5,161,639	91,958,830	11,008,973
1920	1,527,753	3,387,488	10,526,125	45,240,013	5,419,363	66,100,742	7,879,384
1921	435,872	466,345	2,207,365	26,144,323	2,778,931	32,032,836	4,492,063

No domestic exports are recorded.

Value of foreign precious stones reexported from the United States, 1917–1921.

Year.	Diamonds.			Other precious stones.		Total, excluding pearls.	Pearls and parts of, not strung or set.
	Uncut.	Cut but not set.	Bort.	Uncut.	Cut but not set.		
1917	$7,757	$400	$14,962	$1,512	$16,842	$41,473	$20,353
1918			56	100	57	213	42,908
1919	3,238	25,000	(a)	[a] 15,653	1,783	45,674	5,386
1920			(a)	[a] 4,604	13,338	17,942	8,000
1921		896	(a)	[a] 14,390	9,353	24,639	128

[a] Bort included under "Other precious stones—uncut."

GOLD AND SILVER.

PRODUCTION.

Gold and silver produced in the United States, 1917–1921.

Year.	Gold.		Silver.	
	Troy ounces.	Value.	Troy ounces.	Commercial value.
1917	4,051,440	$83,750,700	71,740,362	$59,078,100
1918	3,320,784	68,646,700	67,810,139	66,485,129
1919	2,918,628	60,333,400	56,682,445	63,533,652
1920	2,476,166	51,186,900	55,361,573	60,801,955
1921	2,422,006	50,067,300	53,052,441	53,052,441

According to tables published by the Director of the Mint the total production of gold and silver in the United States is as follows:

Gold and silver produced in the United States, 1792–1921.

[The estimate for 1792–1872 is by R. W. Raymond, commissioner, and for the period since 1872 by the Director of the Mint.]

Period.	Gold.		Silver.	
	Troy ounces.	Value.	Troy ounces.	Commercial value.
1792–1847	1,186,977	$24,537,000	309,500	$401,500
1848–1872	58,279,781	1,204,750,000	118,568,200	157,749,900
1873–1921	140,948,071	2,913,655,200	2,493,566,337	1,980,732,477
	200,414,829	4,142,942,200	2,612,444,037	2,138,886,877

Gold produced in the United States in 1920 and 1921, by States.[a]

State.	1920		1921	
	Troy ounces.	Value.[b]	Troy ounces.	Value.[b]
Alabama	10	$200	4	$100
Alaska	412,915	8,535,700	386,927	7,998,500
Arizona	240,032	4,961,900	160,498	3,317,800
California	716,477	14,810,900	728,590	15,061,300
Colorado	363,218	7,508,400	355,459	7,347,800
Georgia	34	700	53	1,100
Idaho	22,668	468,600	26,229	542,200
Maine			9	200
Massachusetts	10	200		
Missouri	14	300		
Montana	91,802	1,897,700	83,476	1,725,600
Nevada	175,451	3,626,900	155,791	3,220,500
New Mexico	21,720	449,000	9,824	203,100
North Carolina	54	1,100	82	1,700
Oregon	49,714	1,027,700	39,454	815,600
Pennsylvania			24	500
Philippine Islands	61,756	1,276,600	60,705	1,254,900
South Carolina	14	300		
South Dakota	209,842	4,337,800	315,550	6,523,000
Tennessee	285	5,900	241	5,000
Texas	5	100	116	2,400
Utah	102,975	2,128,700	91,636	1,894,300
Virginia			29	600
Washington	7,160	148,000	7,309	151,100
Wyoming	10	200		
	2,476,166	51,186,900	2,422,006	50,067,300

[a] Figures of production issued jointly by the Bureau of the Mint and the Geological Survey.
[b] Gold value, $20.67 + a troy ounce.

Silver produced in the United States in 1920 and 1921, by States.[a]

State.	1920		1921	
	Troy ounces.	Value.[b]	Troy ounces.	Value.[c]
Alabama	5	$5	4	$4
Alaska	822,410	903,228	753,999	753,999
Arizona	5,431,637	5,965,404	2,519,200	2,519,200
California	1,654,653	1,817,256	3,606,708	3,606,708
Colorado	5,166,873	5,674,622	6,310,694	6,310,694
Georgia	4	4	3	3
Idaho	7,364,785	8,088,523	7,200,319	7,200,319
Illinois	8,625	9,473	1,616	1,616
Massachusetts	1,160	1,274	----	----
Michigan	511,664	561,945	316,551	316,551
Missouri	123,094	135,190	63,470	63,470
Montana	13,263,356	14,566,746	9,677,020	9,677,020
Nevada	7,481,866	8,217,109	6,998,774	6,998,774
New Mexico	699,745	768,509	579,374	579,374
North Carolina	10	11	13	13
Oregon	101,658	111,648	53,118	53,118
Pennsylvania	90	99	1,707	1,707
Philippine Islands	22,118	24,292	26,392	26,392
South Carolina	1	1	----	----
South Dakota	87,623	96,234	111,670	111,670
Tennessee	107,250	117,790	106,664	106,664
Texas	522,818	574,195	548,827	548,827
Utah	11,755,411	12,910,615	14,028,661	14,028,661
Virginia	----	----	8	8
Washington	177,758	195,226	147,584	147,584
Wyoming	56,959	62,556	65	65
	55,361,573	60,801,955	53,052,441	53,052,441

[a] Figures of production issued jointly by the Bureau of the Mint and the Geological Survey.
[b] Valued at $1.09827 an ounce, the average of the New York prices, to the end of May, when the Pittman Act (of Apr. 23, 1918), became effective; thereafter at $1 an ounce, as provided by that act.
[c] Valued at $1 an ounce, provided by the Pittman Act of Apr. 23, 1918, for domestic product.

World's production of gold, 1916–1920, by countries.

[Figures supplied by U. S. Bureau of the Mint. See also pp. 513–564.]

Country.	1916	1917	1918	1919	1920
North America:					
United States	$92,590,300	$83,750,700	$68,646,700	$60,333,400	$51,186,900
Canada	19,235,000	15,273,000	14,687,900	15,850,400	15,853,500
Mexico	7,690,700	9,000,000	16,824,700	15,676,500	15,265,900
Central America	3,517,600	3,122,000	3,400,000	3,300,000	3,000,000
South America:					
Argentina	15,300	4,600	4,000	4,000	100,000
Bolivia and Chile	301,000	770,700	770,000	770,000	905,000
Colombia	6,173,900	5,000,000	4,866,500	6,000,000	5,800,000
Ecuador	560,000	887,800	800,000	800,000	750,000
Brazil	2,890,000	2,958,000	2,800,000	2,000,000	2,600,000
Venezuela	1,269,900	636,900	473,200	600,000	389,400
Guiana:					
British	660,700	519,000	400,000	335,200	200,000
Dutch	438,200	445,000	322,200	329,300	258,500
French	1,600,000	1,438,500	1,100,000	1,100,000	900,000
Peru	1,267,400	1,254,100	1,250,000	1,348,400	1,297,300
Uruguay	12,000	10,000	10,000	10,000	400
Europe:					
Russia, Finland and Siberia	22,500,000	18,000,000	12,000,000	11,000,000	1,182,900
Austria-Hungary	1,000,000	150,000	180,000	----	----
Sweden	12,200	10,000	10,000	10,000	4,700
Italy	2,000	700	22,800	15,300	15,000
France	1,000,000	700,000	500,000	151,000	----
Germany	----	----	----	----	91,700
Great Britain	5,700	5,000	----	----	700
Greece	----	----	----	4,600	10,600
Czechoslovakia	----	----	----	125,600	181,100
Yugoslavia	----	----	----	----	66,500

World's production of gold, 1916–1920, by countries—Continued.

Country.	1916	1917	1918	1919	1920
Asia:					
Japan	$5,185,600	$4,679,700	$5,105,900	$4,824,900	$5,130,400
China	3,100,700	3,600,100	3,600,000	3,300,000	2,584,000
Indo-China	65,600	50,000	50,000	40,000	3,300
Chosen (Korea)	4,122,400	3,363,800	3,300,000	2,800,000	1,571,100
India, British	11,206,500	10,812,800	10,028,000	10,486,000	10,316,700
East Indies, British	3,000,000	2,853,700	2,571,400	2,564,000	2,479,500
East Indies, Dutch					
Federated Malay States	327,900	342,400	345,300	339,000	265,700
Formosa	1,001,200	1,081,200	513,700	417,200	279,000
Sarawak				446,000	338,000
Africa	222,948,900	214,304,300	197,073,600	193,896,500	191,339,800
Australasia	40,475,800	34,398,100	29,268,600	26,911,500	22,651,700
	454,176,500	419,422,100	380,924,500	365,788,800	337,019,300

World's production of silver, 1916–1920, by countries, in troy ounces.

[Figures supplied by U. S. Bureau of the Mint. See also pp. 513–564.]

Country.	1916	1917	1918	1919	1920
North America:					
United States	74,414,800	71,740,400	67,810,100	56,682,400	55,361,600
Canada	25,459,700	22,221,300	21,284,600	16,020,700	12,793,500
Mexico	22,838,400	35,000,000	62,517,000	65,904,200	66,662,200
Central America	2,602,500	2,369,500	2,900,000	2,800,000	2,700,000
South America:					
Bolivia and Chile	4,402,100	4,151,600	4,335,000	4,335,000	4,804,400
Argentina	21,300	29,000	25,000	25,000	30,000
Brazil	22,000	25,000	25,000	25,000	30,000
Columbia	309,400	325,000	325,000	494,300	480,000
Ecuador	30,000	45,000	40,000	40,000	35,000
Peru	10,787,000	10,864,400	10,800,000	9,821,700	9,196,300
Guiana and Uruguay	8,500	8,000	8,000	8,000	8,500
Venezuela		3,300	3,000	4,100	3,500
Europe:					
Austria-Hungary	1,500,000	1,500,000	1,750,000	596,400	694,100
Czechoslovakia				12,000	321,500
France					3,305,000
Germany					
Great Britain	86,500	75,000	50,000	68,400	76,400
Greece	350,000	350,000	350,000	160,000	220,900
Italy	486,500	486,500	500,000	350,000	297,500
Yugoslavia					15,000
Norway	439,100	294,900	270,200	312,800	323,200
Spain and Portugal	4,517,800	2,850,000	3,100,000	1,548,200	2,956,500
Russia	550,000	500,000	400,000	400,000	50,000
Serbia	10,000	20,000	20,000	20,000	
Sweden	37,900	35,000	31,500	31,500	11,600
Turkey	500,000	400,000	400,000	100,000	100,000
Asia:					
British India	280,000	275,000	270,000	190,600	170,600
China	30,000	63,900	70,000	65,000	50,000
Chosen (Korea)	25,000	26,500	26,000	20,000	1,200
Dutch East Indies	400,000	400,000	400,000	1,006,800	1,027,900
Indo-China	1,000	1,000	1,000	1,000	
Formosa	47,700	39,600	26,900	25,000	20,000
Japan	5,805,700	7,111,700	6,600,400	4,950,500	4,892,400
Burma	977,100	1,793,700	1,970,500	1,975,000	2,700,000
Sarawak				6,300	5,200
Africa:					
Algeria				170,800	150,000
Belgian Kongo	11,000	10,300	10,500	10,000	10,700
Egypt	1,200	900	800	300	300
French East Africa	20,000	20,000	20,000	17,700	13,800
Madagascar					
Portuguese East Africa	1,200	1,200	1,200	1,000	700
Rhodesia	200,700	212,000	175,700	180,600	164,900
Transvaal, Cape Colony, Natal	968,900	938,100	877,500	891,300	891,300
Australasia	10,700,000	10,000,000	10,000,000	7,188,000	2,684,900
	168,843,000	174,187,800	197,394,900	176,459,600	173,260,600

IMPORTS AND EXPORTS.

Value of gold and silver imported into and exported from the United States, 1920 and 1921.

	Imports.	Exports.	Excess of—	
			Imports.	Exports.
1920.				
Gold:				
Contained in domestic ore and base bullion		$11,260		$11,260
Contained in foreign ore and base bullion	$16,984,171		$16,984,171	
Domestic bullion refined	3,845,775	37,203,349		33,357,574
Foreign bullion refined	322,415,060	1,901,594	320,513,466	
United States coin	18,093,178	282,293,126		264,199,948
Foreign coin	55,730,089	681,879	55,048,210	
	417,068,273	322,091,208	392,545,847	297,568,782
Excess imports over exports			94,977,065	
Silver:				
Contained in domestic ore and base bullion		16,522		16,522
Contained in foreign ore and base bullion	69,845,999	900	69,845,099	
Domestic bullion refined	3,053	4,349,365		4,346,312
Foreign bullion refined	7,871,083	89,961,684		82,090,601
United States coin	2,093,073	14,771,492		12,678,419
Foreign coin	8,246,833	4,516,261	3,730,572	
	88,060,041	113,616,224	73,575,671	99,131,854
Excess exports over imports				25,556,183
1921.				
Gold:				
Contained in domestic ore and base bullion		77,413		77,413
Contained in foreign ore and base bullion	33,564,537	476	33,564,061	
Domestic bullion refined	459,413	1,612,349		1,152,936
Foreign bullion refined	503,136,371	2,005,408	501,130,963	
United States coin	37,966,552	17,921,219	20,045,333	
Foreign coin	116,121,424	2,274,512	113,846,912	
	691,248,297	23,891,377	668,587,269	1,230,349
Excess imports over exports			667,356,920	
Silver:				
Contained in domestic ore and base bullion		13,851		13,851
Contained in foreign ore and base bullion	46,640,993	2,260	46,638,733	
Domestic bullion refined		23,625,091		23,625,091
Foreign bullion refined	7,575,122	21,077,634		13,502,512
United States coin	2,891,952	864,005	2,027,947	
Foreign coin	6,134,604	5,992,558	142,046	
	63,242,671	51,575,399	48,808,726	37,141,454
Excess imports over exports			11,667,272	

PRICES.

Gold is valued by law at $20.67+ a troy ounce. For prices of silver, see statement on page 12A.

GRAPHITE.

PRODUCTION.

Domestic natural graphite sold in the United States, 1917–1921.

Year.	Amorphous.		Crystalline.		Total.	
	Short tons.	Value.	Pounds.	Value.	Short tons.	Value.
1917	8,301	$73,481	10,584,080	$1,094,398	13,593	$1,167,879
1918	6,560	69,455	12,861,839	1,454,799	12,991	1,524,254
1919	3,379	47,716	8,086,191	731,141	7,422	778,857
1920	4,694	49,758	9,632,360	576,444	9,510	626,202
1921	1,842	20,860	1,189,523	75,664	2,437	96,524

Graphite is manufactured by the Acheson Graphite Co. at Niagara Falls, N. Y. The figures given below, published by permission of this company, represent only the manufactured graphite that comes into competition with natural graphite.

Graphite manufactured by the Acheson Graphite Co., 1916–1921, in pounds.

1916	8,397,281	1919	8,163,177
1917	10,474,649	1920	7,399,749
1918	9,182,272	1921	5,888,000

IMPORTS AND EXPORTS.

Graphite imported for consumption in the United States, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	42,930	$7,279,883	1919	26,626	$2,978,096
1917	42,577	8,961,988	1920	21,095	1,711,312
1918	19,498	3,092,475	1921	8,183	452,076

Graphite exported from the United States, 1917–1921.

Year.	Unmanufactured graphite.		Manufactures of graphite.
	Pounds.	Value.	
1917	5,146,816	$349,563	$891,687
1918	1,907,719	121,555	731,518
1919	1,258,040	90,185	788,755
1920	1,213,616	112,771	610,261
1921	1,841,578	95,998	679,359

PRICES.

Prices of best grades of domestic flake graphite (sales at mines) and Ceylon lump (New York prices), in cents per pound, 1916–1921.

Year.	Domestic flake.	Ceylon lump.	Year.	Domestic flake.	Ceylon lump.
1916	10–16	20 –28	1919	5–14	14 –15½
1917	12–18	28 –32	1920	6–13	9 –14
1918	10–17¾	15½–28½	1921	4–13	5½– 6

GRINDSTONES AND PULPSTONES.

[See Abrasive materials.]

GYPSUM.

PRODUCTION.

Gypsum produced and sold in the United States, 1916–1921.

Year.	Crude mined (short tons).	Crude and calcined sold (total value).	Year.	Crude mined (short tons).	Crude and calcined sold (total value).
1916	2,757,730	$7,959,032	1919	2,420,163	$15,727,907
1917	2,696,226	11,116,452	1920	3,129,142	24,533,065
1918	2,057,015	11,470,854	1921	2,890,784	23,700,290

IMPORTS AND EXPORTS.

Gypsum imported into the United States comes almost wholly from Nova Scotia and New Brunswick and enters the ports of New England and other North Atlantic States.

Gypsum imported and entered for consumption in the United States, 1917–1921.

Year.	Unground.		Ground or calcined.		Value of manufactured plaster of Paris.	Keenes cement.		Total value.
	Short tons.	Value.	Short tons.	Value.		Short tons.	Value.	
1917	240,269	$265,504	16,533	$109,732	$6,016	484	$8,003	$389,255
1918	50,653	55,004	6,117	70,028	1,765	111	2,259	129,056
1919	171,733	211,946	10,415	126,405	7,719	187	5,984	352,054
1920	282,486	397,942	14,921	179,191	10,282	202	5,338	592,753
1921	266,796	364,318	4,495	55,109	33,072	184	6,836	459,335

Figures are not available for exports of gypsum.

ILMENITE.

[See Titanium minerals.]

IRON ORE, PIG IRON, AND STEEL.

IRON ORE.

[Exclusive of all domestic ore containing 5 per cent or more of manganese. For data regarding such ore, see Manganese.]

PRODUCTION.

Iron ore mined in the United States in 1920 and 1921, by mining districts and varieties, in long tons.

1920.

District.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
Lake Superior [a]	57,860,530				57,860,530
Birmingham	4,953,653	266,561			5,220,214
Chattanooga	393,733	187,184			580,917
Adirondack			783,590		783,590
Northern New Jersey and southeastern New York			546,365		546,365
Other districts	[b] [c] 675,607	[c] 871,916	[b] 1,061,586	3,740	2,612,849
	[b] [c] 63,883,523	[c] 1,325,661	[b] 2,391,541	3,740	67,604,465

1921.

District.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.	Percentage of decrease in 1921.
Lake Superior [a]	25,298,485				25,298,485	56
Birmingham	2,548,349	180,124			2,728,473	48
Chattanooga	110,096	54,799			164,895	72
Adirondack			446,619		446,619	43
Northern New Jersey and southeastern New York			79,513		79,513	85
Other districts	[b] [c] 380,319	[c] 135,231	[b] 254,734	2,709	772,993	70
	[b] [c] 28,337,249	[c] 370,154	[b] 780,866	2,709	29,490,978	56

[a] Includes only those mines in Wisconsin which are in the true Lake Superior district.
[b] Some magnetite included with hematite.
[c] Some hematite included with brown ore.

Iron ore mined in the United States, 1917–1921, by varieties, in long tons.

Year.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
1917	70,743,513	1,992,332	2,553,006	.....	75,288,851
1918	65,894,709	1,613,844	2,149,725	.....	69,658,278
1919	[a] 57,719,582	1,127,397	[a] 2,118,439	.....	60,965,418
1920	[a] [b] 63,883,523	[b] 1,325,661	[a] 2,391,541	3,740	67,604,465
1921	[a] [b] 28,337,249	[b] 370,154	[a] 780,866	2,709	29,490,978

[a] Some magnetite included with hematite.
[b] Some hematite included with brown ore.

Iron ore mined in the Lake Superior district, 1917–1921, by ranges, in long tons.

Year.	Marquette.	Menominee.	Gogebic.	Vermilion.	Mesabi.	Cuyuna.	Total.
1917	4,638,374	6,366,483	7,881,232	1,481,301	41,127,323	1,986,608	63,481,321
1918	3,946,554	6,041,637	7,837,634	1,192,677	39,055,977	1,705,315	59,779,794
1919	4,158,751	4,863,968	7,368,994	1,051,795	33,262,954	1,685,877	52,392,339
1920	4,457,609	5,651,542	8,298,206	1,053,518	36,641,880	1,757,775	57,860,530
1921	2,204,114	2,147,569	3,135,477	981,576	16,380,190	449,559	25,298,485

Iron ore shipped from mines in the United States in 1920 and 1921, by States.

State.	1920		1921		Percentage of increase or decrease.	
	Long tons.	Value.	Long tons.	Value.	Quantity.	Value.
Alabama	5,833,317	$15,993,985	2,835,761	$5,058,161	− 51	− 68
California	6,592	44,844	2,064	15,364	− 69	− 66
Georgia	104,482	460,633	3,822	13,678	− 96	− 97
Michigan	18,862,578	85,749,217	5,011,804	18,481,225	− 73	− 78
Minnesota	39,747,594	163,538,054	17,648,603	62,780,754	− 56	− 62
Missouri	50,825	230,827	(a)	(a)	(b)	(b)
Montana	10,803	73,889	26,174	91,729	+142	+ 24
New Jersey	417,100	2,595,949	115,132	551,688	− 72	− 79
New Mexico	274,705	547,370	110,528	244,284	− 60	− 55
New York	959,408	6,263,252	174,368	946,366	− 82	− 85
North Carolina	71,810	293,382	(a)	(a)	(b)	(b)
Pennsylvania	719,813	1,406,929	187,062	288,955	− 74	− 79
Tennessee	373,012	1,355,217	25,219	68,726	− 93	− 95
Utah	36,159	151,174	60,773	156,865	+ 68	+ 4
Virginia	320,109	1,227,601	54,353	196,935	− 83	− 84
Wisconsin	1,067,159	4,333,307	117,755	300,954	− 89	− 93
Other States [c]	425,875	740,697	279,110	549,624	−[b]49	−[b]57
	69,281,341	285,006,327	26,652,528	89,745,308	− 62	− 69

[a] Less than three shippers in Missouri and North Carolina in 1921 and permission not granted to publish State totals. Figures for these States therefore included under "Other States."
[b] Decrease for Missouri and North Carolina included under "Other States."
[c] 1920: Arizona, Colorado, Connecticut, Idaho, Maryland, Massachusetts, Nevada, Washington, and Wyoming; 1921: Colorado, Idaho, Maryland, Massachusetts, Missouri, North Carolina, Texas, and Wyoming.

STOCKS.

Stocks of iron ore at mines in the United States, Dec. 31, 1920 and 1921, in long tons.

State.	1920	1921	State.	1920	1921
Alabama	463,341	503,721	New Jersey	269,298	208,657
California	70	.....	New York	154,669	446,879
Georgia	3,885	4,610	North Carolina	.....	2,200
Iowa	12,165	12,165	Pennsylvania	54,400	8,405
Maryland	1,580	.....	Tennessee	3,709	3,709
Massachusetts	1,530	4,368	Virginia	42,630	62,298
Michigan	5,532,368	7,879,344	Wisconsin	341,212	460,161
Minnesota	4,493,158	4,234,952			
Missouri	4,779	4,798		11,378,794	13,836,267

IMPORTS AND EXPORTS.

Iron ore imported into and exported from the United States, 1917–1921.

Year.	Imports.		Exports.	
	Long tons.	Value.	Long tons.	Value.
1917	971,663	$3,655,392	1,132,313	$4,464,111
1918	787,468	3,464,304	1,256,383	5,535,090
1919	476,461	2,385,689	996,569	4,308,746
1920	1,273,456	4,963,654	1,145,037	6,198,927
1921	315,768	1,075,909	440,106	2,077,620

PRICES.

Average value of iron ore per long ton at the mines in the United States, 1917–1921.

Year.	Hematite.	Brown ore.	Magnetite.	Carbonate.	General average.
1917	$3.12	$2.95	$4.29	.....	$3.15
1918	3.35	3.51	4.60	.....	3.39
1919	3.48	3.63	4.08	.....	3.50
1920	4.09	4.19	4.59	(a)	4.11
1921	3.37	2.63	3.61	(a)	3.37

[a] Sold for paint and not included in shipments of iron ore.

Selling prices of iron ore per long ton at lower Lake ports at date of buying movement, 1917–1921.[a]

Season.	Date of buying movement.	Season iron-ore prices.			
		Old range Bessemer.	Mesabi Bessemer.	Old range non-Bessemer.	Mesabi non-Bessemer.
1917	Nov. 22, 1916	$5.95	$5.70	$5.20	$5.05
1918	Apr. 1, 1918	5.95	5.70	5.20	5.05
	July 1, 1918	6.40	6.15	5.65	5.50
	Oct. 1, 1918	6.65	6.40	5.90	5.75
1919	Apr. 28, 1919	6.45	6.20	5.70	5.55
1920	Feb. 2, 1920	7.45	7.20	6.70	6.55
1921	June 16, 1921	6.45	6.20	5.70	5.55

[a] Iron Trade Review.

PIG IRON.

PRODUCTION.

Pig iron shipped from blast furnaces in the United States in 1920 and 1921, by States.

State.	1920		1921					
	Long tons.	Value.	Long tons.	Value.	Decrease.		Percentage of decrease.	
					Long tons.	Value.	Quantity.	Value.
Alabama	2,339,939	$76,520,797	1,241,227	$30,195,978	1,098,712	$46,324,819	47	61
Illinois	3,238,814	90,736,015	1,490,638	36,513,263	1,748,176	54,222,752	54	60
Indiana	2,418,048	61,852,856	1,655,275	36,945,411	762,773	24,907,445	32	40
Kentucky	230,316	7,306,711	28,375	816,372	201,941	6,490,339	88	89
Michigan	464,197	16,812,062	200,944	5,955,205	263,253	10,856,857	57	65
Missouri	81,682	3,678,623	17,028	479,957	64,654	3,198,666	79	87
New Jersey	88,408	3,380,145	(a)	(a)	(a)	(a)	(a)	(a)
New York	2,415,627	89,416,703	786,713	18,212,810	1,628,914	71,203,893	67	80
Ohio	8,229,770	246,326,276	3,649,835	88,473,082	4,579,935	157,853,194	56	64
Pennsylvania	13,472,814	448,251,415	6,072,196	148,350,285	7,400,618	299,901,130	55	67
Tennessee	217,887	9,271,324	21,972	595,850	195,915	8,675,474	90	94
Virginia	390,372	16,086,946	66,916	2,023,268	323,456	14,063,678	83	87
West Virginia	489,689	15,927,822	259,312	6,557,498	230,377	9,370,324	47	59
Wisconsin	363,588	12,355,028	93,666	2,730,155	269,922	9,624,873	74	78
Other States [b]	1,269,076	42,981,373	454,522	11,588,658	902,962	34,772,860	67	75
	35,710,227	1,140,904,096	16,038,619	389,437,792	19,671,608	751,466,304	55	66

[a] Included under "Other States."
[b] 1920: Colorado, Connecticut, Maryland, Massachusetts, and Minnesota; 1921: Colorado, Connecticut, Maryland, Massachusetts, Minnesota, and New Jersey.

Pig iron shipped from blast furnaces in the United States, 1916–1921.

Year.	Long tons.	Value.	Year.	Long tons.	Value.
1916	39,126,324	$663,478,118	1919	30,130,231	$775,915,043
1917	38,612,546	1,053,785,975	1920	35,710,227	1,140,904,096
1918	38,230,440	1,180,759,565	1921	16,038,619	389,437,792

IMPORTS AND EXPORTS.

Pig iron, including kentledge, ferromanganese, ferrosilicon, and spiegeleisen, imported into the United States, 1916–1921.

Year.	Long tons.	Value.	Year.	Long tons.	Value.
1916	135,349	$10,239,868	1919	101,665	$6,565,106
1917	76,786	7,872,105	1920	185,944	12,801,834
1918	34,711	4,968,056	1921	44,036	2,014,926

Pig iron exported from the United States, 1916–1921.

Year.	Long tons.	Value.	Year.	Long tons.	Value.
1916	607,236	$15,381,431	1919	321,261	$12,313,183
1917	656,220	24,037,051	1920	216,828	10,074,377
1918	269,575	11,576,721	1921	28,307	933,093

PRICES.

Average monthly prices per ton of principal grades of pig iron in the United States, 1920 and 1921.[a]

Month.	1920				1921			
	Foundry pig iron at Valley furnaces.	Foundry pig iron at Birmingham, Ala., furnaces.	Bessemer pig iron at Valley furnaces.	Basic pig iron at Valley furnaces.	Foundry pig iron at Valley furnaces.	Foundry pig iron at Birmingham, Ala., furnaces.	Bessemer pig iron at Valley furnaces.	Basic pig iron at Valley furnaces.
January	$38.46	$37.77	$37.65	$36.62	$31.92	$31.14	$32.00	$30.00
February	41.00	40.00	41.67	42.13	28.29	27.50	29.63	27.71
March	42.00	40.00	42.00	41.50	25.89	25.52	26.70	24.41
April	42.42	40.00	42.21	42.13	24.81	23.77	25.00	23.00
May	43.96	42.00	42.54	43.12	23.60	21.80	24.32	22.15
June	45.00	42.00	43.23	43.62	22.42	20.48	22.88	21.20
July	45.15	42.00	45.58	45.42	20.40	20.18	21.34	19.52
August	47.85	42.00	47.35	46.96	19.59	18.70	20.00	18.22
September	50.00	42.00	48.50	48.50	20.86	19.06	20.00	19.00
October	46.62	42.00	47.67	44.60	21.00	19.00	20.00	19.24
November	40.72	39.02	40.84	37.62	20.78	18.56	20.00	19.00
December	35.77	36.42	35.00	33.00	20.00	17.31	20.00	19.00
Average	43.25	40.43	42.85	42.05	23.30	21.92	23.49	21.87

[a] Metal Statistics.

STEEL.

Steel produced in the United States, 1917–1921, in long tons.[a]

Year.	Bessemer.	Open-hearth.	Crucible.	Other steel.	Total.
1917	10,479,960	34,148,893	126,716	305,038	45,060,607
1918	9,376,236	34,459,391	115,112	511,693	44,462,432
1919	7,271,562	26,948,694	63,572	387,404	34,671,232
1920	8,883,087	32,671,895	72,265	505,687	42,132,934
1921	4,015,938	15,589,802	7,613	170,444	19,783,797

[a] According to the American Iron and Steel Institute.

LEAD.

SUPPLY.

Apparent consumption of refined primary lead in the United States (refinery stocks disregarded), 1917–1921, in short tons.

	1917	1918	1919	1920	1921
Supply:					
Stock in bonded warehouses Jan. 1	535	2,685	472	234	1,322
Imports of pigs, bars, and old	5,793	5,240	5,107	35,719	31,301
Production	610,769	640,195	482,220	529,657	448,589
	617,097	648,120	487,799	565,610	481,212
Withdrawn:					
Exports of foreign lead—					
From warehouse	37,652	59,416	40,976	17,363	25,000
In manufactures, with benefit of drawback	7,537	3,426	1,936	6,175	9,369
Exports of domestic lead	53,688	41,831	10,510	2,730	1,624
Stock in bonded warehouses Dec. 31	2,685	472	234	1,322	347
	101,562	105,145	53,656	27,590	36,340
Apparent consumption	515,535	542,975	434,143	538,020	444,872

PRODUCTION.

Refined primary lead produced in the United States, 1917–1921, in short tons.

	1917	1918	1919	1920	1921
Domestic ore:					
Desilverized lead	303,679	282,024	208,751	220,327	187,962
Soft lead	188,503	210,463	147,744	189,854	157,513
Desilverized soft lead	56,268	47,418	67,938	66,668	52,747
Total from domestic ore	548,450	539,905	424,433	476,849	398,222
Foreign ore:					
Africa	1,738	1,519	644	1,171	.....
Australia	.....	282	69	450	.....
Canada	1,100	7,550	1,895	1,186	2,877
Central America	.....	.....	12	22	6
Mexico	7,607	4,798	2,261	2,729	1,912
South America	1,533	1,101	2,537	2,747	2,235
Other foreign	3,894	84	238	109	90
Foreign base bullion:					
Canada	6,750	8,108	567	1,919	1,599
Mexico	39,508	76,809	49,564	42,421	41,648
South America	189	39	.....	54	.....
Total from foreign ore and base bullion	62,319	100,290	57,787	52,808	50,367
Grand total from all sources	610,769	640,195	482,220	529,657	448,589
Production of antimonial lead	18,646	18,570	13,874	12,535	10,064

Refined primary lead produced in the United States from domestic ores, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	552,228	$76,207,000	1919	424,433	$44,990,000
1917	548,450	94,333,000	1920	476,849	76,296,000
1918	539,905	76,667,000	1921	398,222	35,840,000

Secondary lead produced in the United States, 1917–1921, in short tons.

	1917	1918	1919	1920	1921
Pig lead	45,100	41,146	55,684	56,350	46,370
Lead in alloys	48,400	55,954	66,416	68,300	57,410
Total recovered lead	93,500	97,100	122,100	124,650	103,780

IMPORTS AND EXPORTS.

Lead imported into the United States in ore, base bullion, and refined, by sources, 1917–1921, in pounds.

[General imports.]

Year.	Canada.	Mexico.	South America.	Europe.	Other countries.	Total imports.
1917	11,738,379	125,782,759	4,556,460	8,945,899	5,520,323	156,543,820
1918	28,225,878	162,259,199	1,962,124	62,510	4,705,049	197,214,760
1919	10,391,115	125,541,614	5,504,416	89,840	286,142	141,813,127
1920	8,199,234	131,815,278	7,085,351	38,766,504	11,163,160	197,029,527
1921	8,127,158	106,406,238	2,381,365	30,224,701	1,430,949	148,570,411

Lead imported into the United States, by classes, 1917–1921, in pounds.

[General imports.]

Year	Lead in ore (lead content).	Base bullion.		Pigs, bars, sheets, and old.	Total lead content.
		Gross weight.	Lead content.		
1917	41,292,876	109,279,997	103,664,970	11,585,974	156,543,820
1918	37,070,340	155,810,003	149,663,889	10,480,531	197,214,760
1919	19,573,856	115,317,160	112,024,518	10,214,753	141,813,127
1920	29,488,816	101,476,550	96,103,603	71,437,108	197,029,527
1921	14,234,039	77,882,834	71,733,838	62,602,534	148,570,411

Lead imported and entered for consumption in the United States, 1917–1921, by classes.

Year.	Lead in ore.		Base bullion.		Pigs, bars, and old.		Sheets, pipe, and shot.		Not otherwise specified (value).	Total value.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.		
1917	5,438,931	$207,370	6,965,849	$470,539	1,756,223	$85,743	12,538	$2,699	$10,287	$776,638
1918	6,064,902	344,080	3,559,071	180,070	1,139,950	56,694	6,892	624	36,723	618,191
1919	4,106,823	196,363	31,796,693	1,130,937	10,174,115	415,094	8,018	628	17,187	1,760,209
1920	13,700,499	908,619	66,816,820	3,340,600	68,901,959	3,887,821	81,396	5,483	21,328	8,163,851
1921	6,842,807	327,046	56,819,980	1,668,410	61,909,094	1,972,716	3,087	140	11,204	3,979,516

Lead exported from the United States, 1917–1921, by classes.

Year.	Pigs and bars.				Foreign lead used in articles exported with benefit of drawback.[a]		Manufactures of lead from both domestic and foreign ores.
	From domestic ore.		From foreign ore.				
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
1917	107,376,638	$9,560,598	75,304,480	$6,650,157	15,074,947	$1,296,445	$2,288,205
1918	83,662,322	5,889,381	118,832,344	8,309,798	6,852,173	350,851	1,828,473
1919	21,019,605	1,471,256	81,951,396	4,536,273	3,872,130	207,087	2,155,436
1920	5,459,713	462,223	34,725,501	2,570,535	12,350,794	536,322	3,621,397
1921	3,247,294	177,926	50,000,259	2,284,107	18,738,927	(b)	1,376,259

[a] Exclusive of lead that entered as pig and was exported in the same form, which would be duplicated in exports of lead from foreign ore.
[b] Figures not available.

Pig lead exported from the United States, 1919–1921, by destination, in short tons.

Destination.	1919		1920		1921	
	Domestic.	Foreign.	Domestic.	Foreign.	Domestic.	Foreign.
Canada	657	1,418	364	1,357	170	40
Great Britain	3,039	20,174	252	2,439	3	13,154
Netherlands	246	616	146	1,871	118	1,401
France	2,208	1,120	23	1,008	616	224
Russia	5				3	
Japan	392	11,452	392	3,584	28	4,200
Other countries	3,963	6,196	1,553	7,104	686	5,981
	10,510	40,976	2,730	17,363	1,624	25,000

LIME.

PRODUCTION.

Lime burned and sold in the United States, 1917–1921.

Year.	Short tons.	Value.[a]	Average value.	Number of plants in operation.
1917	3,786,364	$23,807,877	$6.29	595
1918	3,206,016	26,808,909	8.36	496
1919	3,330,347	29,448,553	8.84	539
1920	3,570,141	37,543,840	10.52	515
1921	2,532,153	24,895,370	9.83	520

[a] The value given represents the value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.

Hydrated lime manufactured and sold in the United States, 1917–1921.

Year.	Short tons.	Value.	Average value.	Number of plants in operation.
1917	709,157	$4,643,004	$6.55	90
1918	620,216	5,342,113	8.61	90
1919	777,408	7,061,146	9.08	93
1920	853,116	9,287,562	10.89	98
1921	792,970	7,421,637	9.36	105

IMPORTS AND EXPORTS.

Lime imported and entered for consumption in the United States, 1916–1921.[a]

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	7,959	$71,663	1919	8,679	$128,519
1917	7,353	70,505	1920	22,688	392,137
1918	6,650	73,458	1921	10,811	234,798

[a] Most of the lime imported into the United States comes from Canada.

Lime exported from the United States, 1916–1921.

Year.	Short tons.	Value.	Average value.	Year.	Short tons.	Value.	Average value.
1916	23,973	$132,769	$5.54	1919	6,372	$108,370	$17.01
1917	18,794	168,671	8.97	1920	5,921	128,296	21.67
1918	7,191	105,803	14.71	1921	5,192	109,769	21.14

LITHIUM MINERALS.

PRODUCTION.

Lithium minerals produced in the United States, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	619	$12,035	1919	6,287	$115,000
1917	2,062	42,912	1920	11,696	173,002
1918	5,894	111,600	1921	1,833	33,508

IMPORTS AND EXPORTS.

Imports and exports of lithium minerals are not reported separately.

LITHOGRAPHIC STONE.

PRODUCTION.

During 1913 and 1914 small quantities of lithographic stone were quarried at Brandenburg, Meade County, Ky. No domestic production was reported for 1915 nor has any been reported since 1918.

Lithographic stone produced in the United States, 1916–1918.

Year.	Pounds.	Value.
1916	40,000	$1,500
1917	5,832	489
1918	6,000	350

IMPORTS AND EXPORTS.

Lithographic stone imported for consumption in the United States, 1916–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1916	(a)	$749	1919	464,914	$216,293
1917	.....	.....	1920	786,119	63,733
1918	.....	.....	1921	301,546	34,101

[a] Quantity not recorded.

Exports of lithographic stone are not separately shown.

MAGNESITE.

PRODUCTION.

Crude domestic magnesite sold or treated in the United States, 1917–1921.

Year.	California.		Washington.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	211,663	$2,116,630	105,175	$783,188	316,838	$2,899,818
1918	84,077	761,811	147,528	1,050,790	231,605	1,812,601
1919	50,020	504,973	106,206	743,442	156,226	1,248,415
1920	81,782	1,083,262	221,985	1,664,888	303,767	2,748,150
1921	47,904	510,177	.....	.....	47,904	510,177

IMPORTS AND EXPORTS.

Magnesite imported for consumption in the United States, 1919–1921.

	1919		1920		1921	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Calcined, not purified	9,471	$270,721	14,780	$373,165	6,788	$250,932
Crude	6,381	103,311	33,550	406,204	51,993	525,452

Exports are negligible and are not recorded.

MAGNESIUM.

PRODUCTION.

Metallic magnesium produced in the United States, 1917–1921.

Year.	Number of producers.	Pounds.	Value.	Average value.	
				Stick.	Powder.
1917	5	115,813	$233,626	$2.02	.....
1918	4	284,118	615,217	1.81	$2.67
1919	3	127,465	247,302	1.83	2.85
1920	2	(a)	(a)	1.60	2.75
1921	1	10,044	(a)	1.30	2.25

[a] Only 2 producers in 1920 and 1 in 1921, and Survey not at liberty to show figures.

IMPORTS AND EXPORTS.

Magnesium imported into the United States, 1918–1921.

Year.	Pounds.	Value.	Average value.
1918—July to December [a]	11,899	$16,259	$1.37
1919	13,239	13,583	1.02
1920	29,275	25,055	.85
1921	39,913	30,592	.77

[a] Prior to 1915 the entire domestic supply was imported, but such imports are not separately shown until July, 1918.

No separate record of exports of magnesium is kept.

MANGANESE.

SUPPLY.

Manganese alloys and ore produced in the United States and imported from important foreign sources, 1917–1921, in long tons.

Year.	Steel.	Ferromanganese.		Spiegeleisen.		Manganese ore.				
	Production.[a]	Shipments.	Imports	Shipments.	Imports	Shipments.[b]	Total imports.	Imports from—		
								Russia.	India.	Brazil.
1917	45,060,607	260,225	41,969	189,241	3,968	129,351	629,972	.....	48,975	512,517
1918	44,462,432	306,076	27,168	263,861	1,969	305,869	491,303	.....	29,275	345,877
1919	34,671,232	198,255	33,022	90,855	27	54,957	333,344	6,916	9,200	246,592
1920	42,132,934	276,594	59,254	103,672	5,234	94,420	[c]599,764	18,762	71,238	421,523
1921	19,783,797	111,374	9,077	69,230	307	13,531	[c]392,606	.....	113,730	262,468

[a] According to American Iron and Steel Institute.
[b] Exclusive of small quantities of ore shipped for fluxing purposes.
[c] Exclusive of 7,173 tons in 1920 and 8,748 tons in 1921 reported by Bureau of Foreign and Domestic Commerce as manganese ore. The value of this "ore" ranged from $46 to $292 a ton, consequently the Survey believes that the figures represent imports of ferromanganese, spiegeleisen, manganese chemicals, and perhaps some chemical ore.

PRODUCTION.

Manganese and manganiferous ore (exclusive of fluxing ore) shipped from mines in the United States, 1917–1921.

Year.	Ore containing 35 per cent of manganese or more.		Ore containing 10 to 35 per cent of manganese.		Ore containing 5 to 10 per cent of manganese.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
1917	129,351	$4,109,632	576,608	$2,777,171	108,409	$283,271
1918	305,869	8,240,386	818,003	4,445,005	236,103	977,118
1919	54,957	1,791,118	211,632	965,660	112,303	352,570
1920	94,420	2,396,235	357,279	1,450,518	279,687	644,572
1921	13,531	495,097	8,439	42,755	62,670	147,576

[a] In previous reports fluxing ore has been included with ore for chemical and ferroalloy purposes in arriving at total shipments of manganese and manganiferous ore. As fluxing ore does not enter the manganese market under normal conditions, it has been excluded from the above totals and is shown in the following table.

Manganese and manganiferous ore (for fluxing purposes) shipped from mines in the United States, 1917–1921.

Year.	Ore containing 35 per cent of manganese or more.		Ore containing 10 to 35 per cent of manganese.		Ore containing 5 to 10 per cent of manganese.[a]	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
1917	54	$90	154,151	$259,121	21,776	$86,498
1918	.....	.....	98,160	158,785	18,196	54,671
1919	365	5,745	98,202	216,868	11,596	17,394
1920	.....	.....	123,970	332,615	6,728	10,093
1921	.....	.....	22,962	[b]57,000	3,028	[b]7,800

[a] Includes small quantities of ore containing less than 5 per cent of manganese. For such figures see p. 49.
[b] Estimated.

Manganiferous silver ore shipped from mines in the United States, 1917–1921, in long tons.

Year.	Arizona.	Colorado.	Nevada.	New Mexico.	Utah.
1917	32,409	124,715	122,872	.....	100
1918	10,854	124,041	80,096	475	.....
1919	1,964	40,824	77,815	250	.....
1920	345	45,726	95,142	541	.....
1921	.....	11,743	14,871	300	.....

Manganiferous iron ore shipped from the Cuyuna district, Minn., 1916–1921, in long tons.

Year.	Ore containing 10 to 35 per cent of manganese.	Ore containing 5 to 10 per cent of manganese.	Year.	Ore containing 10 to 35 per cent of manganese.	Ore containing 5 to 10 per cent of manganese.
1916	193,257	45,712	1919	138,952	98,220
1917	359,542	91,590	1920	293,524	248,913
1918	625,009	227,202	1921	.....	56,530

MANGANIFEROUS ZINC RESIDUUM.

Manganiferous zinc residuum containing 12 to 15 per cent of manganese and 40 per cent of iron is recovered from roasted franklinite concentrates. No price is given for this material, as it is not sold in the open market, but is reduced to spiegeleisen by the company that produces it.

Manganiferous residuum produced from zinc roasting in the United States and shipped, 1916–1921, in long tons.

1916	198,817	1919	80,418
1917	155,332	1920	133,602
1918	146,796	1921	12,627

MARL.

Calcareous marl sold in the United States, 1917–1921.

Year.	Short tons.	Value.	Average value.
1917	73,900	$165,223	$2.24
1918	98,694	261,082	2.65
1919	91,437	327,294	3.58
1920	97,487	322,339	3.31
1921	59,730	195,743	3.28

Greensand marl is produced in New Jersey. The quantity mined in 1921 was 2,058 short tons, valued at $10,200.

No imports or exports of marl are reported.

MICA.

PRODUCTION.

Domestic mica sold in the United States, 1917–1921.

Year.	Sheet mica.		Scrap mica.		Total.	
	Pounds.	Value.	Short tons.	Value.	Short tons.	Value.
1917	1,276,533	$753,874	3,429	$52,908	4,067	$806,782
1918	1,644,200	731,810	2,292	33,130	3,114	764,940
1919	1,545,709	483,567	3,258	58,084	4,031	541,651
1920	[a] 1,683,480	[a] 546,972	5,723	167,017	[a] 6,565	[a] 713,989
1921	[a] 741,845	[a] 118,513	2,577	56,849	[a] 2,948	[a] 175,362

[a] The figures for sheet mica in 1920 and 1921 are not strictly comparable with those of earlier years, as they represent uncut sheet mica exclusively. Prior to 1920 some cut sheet mica was included—the cutting having the two-fold effect of reducing the quantity and of increasing the value.

Domestic mica sold in the United States in 1920 and 1921, by States.

State.	Sheet mica.		Scrap mica.		Total.	
	Pounds.	Value.	Short tons.	Value.	Short tons.	Value.
1920.						
Alabama	81,458	$16,401	222	$5,234	263	$21,635
Georgia	50,095	13,692	101	3,015	126	16,707
New Hampshire	284,862	83,811	435	12,877	577	96,688
North Carolina	1,084,946	405,654	2,823	91,653	3,365	497,307
Texas	(a)	(a)	427	8,995	(a)	(a)
Virginia	179,339	26,189	(a)	(a)	(a)	(a)
Undistributed [b]	2,780	1,225	1,715	45,243	2,234	81,652
	1,683,480	546,972	5,723	167,017	6,565	713,989
1921.						
Georgia	12,730	2,640	75	1,700	81	4,340
New Hampshire	491,743	63,249	537	10,613	783	73,862
North Carolina	230,532	51,851	1,353	30,496	1,468	82,347
South Dakota			92	2,290	92	2,290
Undistributed [c]	6,840	773	520	11,750	524	12,523
	741,845	118,513	2,577	56,849	2,948	175,362

[a] Included under "Undistributed."
[b] Includes items designated "a," and also Colorado, Idaho, New Mexico, and South Dakota.
[c] Colorado, New Mexico, Virginia, and Wisconsin.

IMPORTS AND EXPORTS.

Mica imported for consumption in the United States, 1917–1921.

Year.	Sheet.				Ground.		Total.	
	Unmanufactured.		Cut and splittings.					
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1917	656,391	$414,823	(a)	$1,014,181	92,963	$1,044	(a)	$1,430,048
1918	741,429	658,576	(a)	880,906	11,587	1,647	(a)	1,541,129
1919	723,713	726,532	(a)	762,228	62	9	(a)	1,488,769
1920	1,298,537	1,177,943	(a)	2,011,434			(a)	3,189,377
1921	328,444	331,219	(a)	758,521	134,650	2,166	(a)	1,091,906

[a] Quantity not reported.

Mica exported from the United States, 1917–1921.

Year.	Unmanufactured.		Manufactured.	Total value
	Pounds.	Value.		
1917	[a] 11,771	$3,073	$71,412	$74,485
1918	[b]	[b]	[b]	74,529
1919	[b]	[b]	[b]	109,348
1920	[b]	[b]	[b]	316,169
1921	[b]	[b]	[b]	153,990

[a] For six months, January to June.
[b] Unmanufactured and manufactured not separately stated.

MILLSTONES.

[See Abrasive materials.]

MINERAL PAINTS.

Domestic zinc and lead pigments,[a] made directly from ores, sold in the United States, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	135,606	$23,515,803	1919	155,648	$25,810,671
1917	140,636	26,972,137	1920	143,244	24,564,572
1918	135,746	26,464,590	1921	102,463	14,801,032

[a] Include sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.

The canvass of natural mineral pigments was discontinued after 1915. Iron ore sold for paint in 1921 amounted to 10,379 long tons, valued at $56,824.

MINERAL WATERS.

PRODUCTION.

Domestic mineral waters sold in the United States, 1917–1921.

Year.	Commercial springs.	Gallons.	Value.	Average value (cents).
1917	717	46,784,419	$4,931,710	10.5
1918	569	40,709,722	4,533,001	11.1
1919	527	38,697,280	4,880,186	12.6
1920	479	36,218,260	4,860,915	13.4
1921	456	34,781,238	4,876,445	14.0

IMPORTS AND EXPORTS.

Mineral waters imported for consumption in the United States, 1917–1921.

Year.		Gallons.	Value.	Average value (cents).
1917		618,405	$268,665	43
1918	Natural and artificial, Jan.–June	258,791	123,695	49
	Natural [a], July–Dec.	200,786	102,970	
	Artificial [a], July–Dec.	29,910	14,976	
1919	Natural	193,933	112,732	58
	Artificial	9,081	4,216	
1920	Natural	466,547	177,992	39
	Artificial	60,567	25,909	
1921	Natural	498,090	156,297	32
	Artificial	26,675	10,804	

[a] Not separately shown prior to July, 1918.

Large quantities of a few domestic waters are exported, but no statistics regarding such exports are available.

MOLYBDENUM.

PRODUCTION.

No molybdenum ores are known to have been mined in the United States during 1921. The closing of the mines was due to the lack of market.

Molybdenum in ore and concentrates produced in the United States and sold, 1916–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1916	206,740	$205,000	1919	297,926	$341,814
1917	350,200	495,350	1920	34,900	17,207
1918	861,637	1,253,700	1921		

IMPORTS AND EXPORTS.

Molybdenum ore (steel-hardening) imported for consumption in the United States, 1918–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1918—July to December [a]	140,222	$123,924	1920	15,639	$9,707
1919	106,743	77,572	1921	29,783	20,471

[a] Not separately classified prior to July, 1918.

For imports of ferromolybdenum see under Ferroalloys. Exports of ferromolybdenum are not separately classified.

NICKEL.

PRODUCTION.

From 1910 to 1918 the United States produced no nickel from domestic materials except as a by-product of copper refining, as shown in the following table. In 1919, however, the production of

nickel was begun from complex sulphides mined on the property of the Missouri Cobalt Co. near Fredericktown, Mo. In 1920 the company produced 80,626 pounds of shot nickel and 256,767 pounds of nickel hydrate, though it did not operate during the whole year. By-product nickel isolated by electrolytic copper refineries amounted to 227 tons, valued at $189,889. In 1921 trade conditions were so bad that again the production was confined to nickel isolated as a by-product in electrolytic copper refining. Large quantities of nickel matte imported from Canada and smaller quantities of matte from New Caledonian ore are, however, refined in the United States, though only Canadian matte was refined in 1920 and 1921.

Nickel content of nickel salts and metallic nickel produced in the United States as a by-product in the electrolytic refining of copper, 1916–1921, and from mixed ores in 1919 and 1920.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	918	$671,192	1919[a]	511	$434,485
1917	402	331,556	1920[a]	365	293,250
1918	441	401,000	1921	111	86,000

[a] Including nickel produced from copper-lead-cobalt-nickel ores mined in Missouri.

IMPORTS AND EXPORTS.

Nickel imported for consumption in the United States, 1917–1921.

Year.	Nickel, nickel ore and matte, nickel oxide, and alloys of nickel with copper, etc.		Manufactures and nickel sheets and strips.	Total value.
	Pounds.	Value.		
1917	75,526,767	$9,617,163	$45,248	$9,662,411
1918	73,207,147	11,520,775	115,243	11,636,018
1919	36,562,388	8,334,135	90,451	8,424,586
1920	48,492,076	10,657,193	200,464	10,857,657
1921	4,396,119	1,210,317	107,155	1,317,472

Nickel imported for consumption in the United States, 1920 and 1921, by forms.

Form.	1920		1921	
	Pounds.	Value.	Pounds.	Value.
Nickel ore (nickel content)	1,541,237	$145,723	660,067	$129,053
Nickel matte (nickel content)	40,044,871	8,318,149	1,382,111	303,733
Nickel, alloys, pig, bars, etc	6,905,753	2,193,256	2,324,993	770,021
Nickel oxide	215	65	28,948	7,510
All other manufactures	.....	200,464	.....	107,155
	.....	10,857,657	.....	1,317,472

Nickel ore and matte imported into the United States, 1920 and 1921, by countries.

[General imports.]

Country.	Nickel ore and matte.			Manufactures.
	Short tons.	Nickel content (pounds).	Value.	
1920.				
Australia	1,210	1,396,001	$361,698	
Austria				$5
Belgium	787	857,381	228,242	253
Canada	33,182	37,737,459	7,723,278	2,179,494
Chosen				109
Denmark				39
England				125,108
France				3,594
Germany				23,083
Japan				12,666
Netherlands				66
Oceania (French)	1,389	1,595,267	150,654	
Poland and Danzig				1,324
Sweden				2
Switzerland				49,959
Turkey in Asia				308
	36,568	41,586,108	8,463,872	2,396,010
1921.				
Austria				576
Belgium	112	174,899	42,688	1,925
Canada	1,576	1,867,279	390,098	708,526
Denmark				5
England				75,231
France				8,175
Germany				59,330
Italy				7,165
Japan				6,562
Netherlands				36
Scotland				170
Spain				6
Sweden				77
Switzerland				16,222
	1,688	2,042,178	432,786	884,006

Nickel, nickel oxide, and matte exported from the United States, 1916–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1916	33,404,011	$12,952,493	1919	3,810,656	$1,697,544
1917	21,992,820	8,936,620	1920	1,215,232	574,845
1918	17,469,500	6,927,041	1921	425,851	103,372

OILSTONES AND SCYTHESTONES.

[See Abrasive materials.]

ORE.

Crude metallic ores shipped from or treated at the mine in the United States, 1917–1921, in short tons.

[Figures rounded.]

Class of ore.	1917	1918	1919	1920	1921
Aluminum ore (bauxite)[a]	637,000	678,000	422,000	584,000	156,000
Chromite	49,000	92,000	6,000	3,000	300
Dry and siliceous (gold and silver) ore	12,166,000	9,702,000	9,302,000	8,590,000	8,418,000
Iron ore [b]	84,521,000	80,572,000	63,050,000	77,539,000	29,750,000
Manganese ore (35 per cent or more Mn.)[b]	145,000	343,000	62,000	106,000	15,000
Manganiferous ore (5 to 35 per cent Mn.)[b]	767,000	1,181,000	363,000	713,000	80,000
Quicksilver ore	280,000	416,000	188,000	109,000	35,000
Copper ore:					
Western States	45,159,000	49,985,000	27,841,000	30,236,000	9,221,000
Central States	12,401,000	11,321,000	7,690,000	5,939,000	3,611,000
Eastern States	923,000	983,000	591,000	590,000	564,000
	58,483,000	62,289,000	36,122,000	36,765,000	13,396,000
Copper-lead and copper-lead-zinc ore	32,000	16,000	18,000	27,000	14,000
Lead ore:					
Western States	2,431,000	2,356,000	1,815,000	2,368,000	2,054,000
Central States	5,888,000	5,533,000	4,304,000	4,822,000	5,075,000
Eastern States	32	43	8,000	10,000	.....
	8,319,000	7,889,000	6,127,000	7,200,000	7,129,000
Lead-zinc ore:					
Western States	2,808,000	2,352,000	1,366,000	1,444,000	122,000
Central States	18,906,000	13,053,000	[c] 10,234,000	[c] 10,939,000	[c] 3,614,000
Eastern States	99,000	58,000	.....	.....	.....
	21,813,000	15,463,000	[c] 11,600,000	[c] 12,383,000	[c] 3,736,000
Zinc ore:					
Western States	642,000	210,000	89,000	482,000	10,000
Central States	212,000	46,000	[c] 949,000	[c] 1,058,000	[c] 933,000
Eastern States	1,660,000	1,313,000	1,331,000	1,111,000	765,000
	2,514,000	1,569,000	[c] 2,369,000	[c] 2,651,000	[c] 1,708,000
Grand total	189,726,000	180,210,000	129,629,000	146,670,000	64,437,000

[a] Figures represent ore mined.
[b] Exclusive of fluxing ore.
[c] Prior to 1919 practically all the zinc-bearing ores in Central States were classed as lead-zinc ores. In 1919–1921 a closer separation was made so that the figures are not comparable with earlier years.

PEAT.

PRODUCTION.

Crude air-dried peat used in the United States, 1917–1921.

Year.	Fertilizer and fertilizer ingredient.		Stock food.		Fuel.		Other products.[a]		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	92,263	$658,500	5,100	$51,400	.....	.....	.....	.....	97,363	$709,900
1918	79,573	775,313	7,096	106,935	20,567	$164,745	25	$250	107,261	1,047,243
1919	54,690	557,240	6,402	98,940	(b)	(b)	8,105	49,352	69,197	705,532
1920	63,272	773,635	[c] 9,182	[c] 143,047	750	5,050	(c)	(c)	73,204	921,732
1921	29,460	251,046	[d] 946	[d] 9,073	(d)	(d)	(d)	(d)	30,406	260,119

[a] Peat moss, paper stock, and packing material. Also peat fuel in 1919.
[b] Included under "Other products."
[c] Small quantity of miscellaneous products included under "Stock food."
[d] Small quantity of fuel and miscellaneous products included under "Stock food."

IMPORTS.

Peat moss imported for consumption in the United States, 1916–1921.

Year.	Short tons.	Value.	Average value.	Year.	Short tons.	Value.	Average value.
1916	3,042	$27,859	$9.16	1919	464	$16,345	$35.23
1917	506	4,966	9.81	1920	2,762	36,201	13.11
1918				1921	3,450	22,754	6.60

No exports of peat are reported.

PETROLEUM.

PRODUCTION.

Petroleum produced in the United States, 1917–1921, by fields.

[Barrels of 42 United States gallons.]

Field.	1917		1918		1919	
	Barrels.	Value at wells.	Barrels.	Value at wells.	Barrels.	Value at wells.
Appalachian	24,932,205	$77,786,495	25,401,466	$93,917,171	31,830,000	$113,876,000
Lima-Indiana [a]	3,670,293	7,102,326	3,220,722	7,450,932	3,486,000	8,453,000
Illinois	15,776,860	31,358,069	13,365,974	31,230,000	11,960,000	29,720,000
Mid-Continent	163,506,205	282,796,124	179,383,098	393,031,158	193,147,000	417,701,000
Gulf	24,342,879	26,087,587	24,207,620	41,053,846	23,366,000	27,957,000
California	93,877,549	86,161,764	97,531,997	118,770,790	101,183,000	142,611,000
Rocky Mountain	9,199,310	11,322,248	12,808,896	18,474,078	13,383,000	19,898,000
Other fields [b]	10,300	20,600	7,943	15,986	12,000	50,000
	335,315,601	522,635,213	355,927,716	703,943,961	378,367,000	760,266,000

	1920		1921	
	Barrels.	Value at wells.	Barrels.	Value at wells.
Appalachian	30,630,000	$163,994,000	30,451,000	$87,896,000
Lima-Indiana	2,407,000	8,757,000	2,404,000	5,423,000
Illinois and southwest Indiana	11,427,000	41,949,000	10,934,000	22,486,000
Mid-Continent	250,111,000	840,700,000	258,461,000	426,720,000
Gulf	27,682,000	75,595,000	36,371,000	43,037,000
California	103,377,000	178,395,000	112,600,000	203,138,000
Rocky Mountain	17,282,000	51,294,000	20,950,000	26,033,000
Other fields [b]	13,000	61,000	12,000	12,000
	442,929,000	1,360,745,000	472,183,000	814,745,000

[a] Includes southwest Indiana.

[b] 1917 and 1918: Alaska and Michigan; 1919: Alaska, Michigan, Missouri, and New Mexico; 1920: Alaska, Arkansas, Missouri, New Mexico, and Utah; 1921: Alaska, Missouri, and New Mexico.

Petroleum produced in the United States, 1919–1921, by States.

State.	1919		1920		1921	
	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.
Alaska	(a)	(a)	(a)	(a)	(a)	(a)
Arkansas			(a)	(a)	10,473,000	$12,746,000
California	101,183,000	$142,611,000	103,377,000	$178,395,000	112,600,000	203,138,000
Colorado	121,000	183,000	111,000	199,000	108,000	132,000
Illinois	11,960,000	29,720,000	10,774,000	39,583,000	10,043,000	20,632,000
Indiana	972,000	2,284,000	945,000	3,407,000	1,158,000	2,414,000
Kansas	33,048,000	77,026,000	39,005,000	133,469,000	36,456,000	68,694,000
Kentucky	9,278,000	24,597,000	8,738,000	34,279,000	9,013,000	16,736,000
Louisiana	17,188,000	26,803,000	35,714,000	112,606,000	27,103,000	42,469,000
Michigan	(a)	(a)				
Missouri	(a)	(a)	(a)	(a)	(a)	(a)
Montana	90,000	171,000	340,000	1,045,000	1,509,000	2,373,000
New Mexico	(a)	(a)	(a)	(a)	(a)	(a)
New York	851,000	3,500,000	906,000	5,433,000	988,000	3,262,000
Ohio	7,736,000	23,333,000	7,400,000	37,338,000	7,335,000	21,512,000
Oklahoma	86,911,000	184,100,000	106,206,000	356,439,000	114,634,000	183,185,000
Pennsylvania	8,137,000	33,688,000	7,438,000	44,464,000	7,418,000	24,746,000
Tennessee	15,000	37,000	14,000	50,000	12,000	21,000
Texas	79,366,000	157,729,000	96,868,000	313,781,000	106,166,000	162,663,000
Utah			(a)	(a)		
West Virginia	8,327,000	34,890,000	8,249,000	50,146,000	7,822,000	26,482,000
Wyoming	13,172,000	19,544,000	16,831,000	50,050,000	19,333,000	23,528,000
Undistributed [b]	12,000	50,000	13,000	61,000	12,000	12,000
	378,367,000	760,266,000	442,929,000	1,360,745,000	472,183,000	814,745,000

[a] Included under "Undistributed."

[b] 1919: Alaska, Michigan, Missouri, and New Mexico; 1920: Alaska, Arkansas, Missouri, New Mexico, and Utah; 1921: Alaska, Missouri, and New Mexico.

World's production of petroleum in 1920 and since 1857, by countries.

[For additional data, see pp. 513-564.]

Country.	1920				1857–1920			
	Barrels.	Metric tons.	Cubic meters.	Percentage by volume.	Barrels.	Metric tons.	Cubic meters.	Percentage by volume.
United States	442,929,000	62,122,000	70,418,000	63.8	5,429,220,000	729,574,000	863,139,000	62.1
Mexico	[a] 163,540,000	24,410,000	26,000,000	23.5	536,524,000	80,047,000	85,287,000	6.1
Russia	[b] 25,429,600	3,471,130	4,042,800	3.6	1,904,021,000	252,072,000	302,701,000	21.8
Dutch East Indies	17,529,210	[c] 2,365,347	2,786,840	2.5	219,584,000	29,690,000	34,910,000	2.5
Persia [d]	12,352,655	1,685,219	1,963,825	1.8	[e] 48,070,000	6,558,000	7,642,000	.5
India [f]	7,500,000	1,000,000	1,192,006	1.1	122,583,000	16,343,000	19,488,000	1.4
Rumania	7,435,344	[g] 1,034,123	1,182,110	1.1	165,462,000	23,013,000	26,305,000	1.9
Poland (Galicia)	5,606,116	[h] 764,818	891,260	.8	171,263,000	23,700,000	27,228,000	2.0
Peru [i]	2,816,649	373,280	447,797	.4	29,797,000	3,968,000	4,737,000	
Japan and Formosa	[j] 2,139,777	285,076	340,180	.3	42,810,000	5,708,000	6,806,000	
Trinidad	[k] 2,083,027	289,712	331,160	.3	11,356,000	1,580,000	1,805,000	
Argentina	1,665,989	[l] 242,502	264,859	.2	7,225,000	1,043,000	1,149,000	
Egypt [m]	1,042,000	152,120	165,660	.2	6,990,000	1,017,000	1,111,000	
British Borneo (Sarawak) [d]	1,015,949	146,285	161,516	.2	[e] 4,052,000	584,000	644,000	
Venezuela	456,996	[n] 69,539	72,653		1,335,000	203,000	212,000	1.7
France (Alsace)	388,700	[p] 54,900	61,800		[q] 723,000	102,000	115,000	
Germany	212,046	[r] 29,950	33,711		17,120,000	2,318,000	2,722,000	
Canada	[s] 196,937	26,258	31,310	.2	24,864,000	3,315,000	3,953,000	
Italy	34,180	[t] 4,750	5,434		1,042,000	148,000	166,000	
Algeria	3,916	[r] 609	623		37,000	6,000	6,000	
England [u]	2,909	382	462		5,000	56,000	67,000	
Other					416,000			
	694,381,000	98,528,000	110,394,000	100.0	8,744,499,000	1,181,045,000	1,390,193,000	100.0

[a] Department of Industry, Commerce, and Labor, Mexico (preliminary).
[b] Soviet records translated by Russian division, Bureau of Foreign and Domestic Commerce, Commerce Rept. 164, p. 286.
[c] Bureau of Mines, Dutch East Indies.
[d] Imperial Mineral Resources Bureau Statistical Summary (London).
[e] 1913–1920 inclusive.
[f] Estimated by Imperial Mineral Resources Bureau (London).
[g] Moniteur du pétrole roumain, Feb. 15, 1921.
[h] Przeglad Naftowy, Rok 1, No. 1, p. 15, March, 1921.
[i] Cuerpo de ingenieros de minas del Peru.
[j] Economic Review, Apr. 29, 1921.
[k] Mines Department, Trinidad.
[l] Director General of Mines, Geology, and Hydrology, Buenos Aires.
[m] Minister of Finance, Cairo.
[n] Memoria del ministerio del fomento.
[p] Imperial Institute, London.
[q] 1919 and 1920.
[r] Consular Report.
[s] Department of Mines, Ottawa (preliminary report).
[t] Minister of Agriculture, Rome.
[u] H. M. Petroleum Executive, London.

STOCKS.

Stocks of crude petroleum held in the United States on December 31, 1917–1921.

[Thousands of barrels of 42 U. S. gallons.]

Year.	Pipe-line and tank-farm stocks of domestic petroleum, by field of origin.								Producers' stocks.[b]	Stocks of Mexican petroleum held in the United States by importers.	Total.	
	Appalachian field.	Lima-Indiana field.	Illinois-southwest Indiana field.	Mid-Continent field.	Gulf Coast field.	Rocky Mountain field.	California field.[a]	Total.			Quantity.[c]	Days' supply.[d]
1917	3,821	1,906	3,560	99,426	8,385	515	32,450	150,063	9,389	(e)	159,452	154
1918	3,616	1,029	2,367	79,094	8,168	236	32,043	126,553	2,033	(e)	128,586	114
1919	3,757	1,122	4,395	76,712	12,575	164	30,480	129,205	4,089	2,919	136,213	118
1920	3,673	1,286	3,495	91,696	12,311	299	22,240	135,000	3,586	7,442	146,028	101
1920 *f*	3,427	1,038	2,965	75,690	11,163	636	22,240	117,159	3,586	7,442	128,187	88
1921	6,838	1,014	7,567	102,401	17,606	1,635	35,022	172,083	5,139	13,540	190,762	132

a From Standard Oil Bulletin; figures include, in addition to gross pipe-line and tank-farm stocks, some unfinished products of topping plants that were turned back to pipe lines, and also producers' stocks.
b Exclusive of producers' stocks in California.
c Exclusive of stocks of crude petroleum held at refineries.
d Based on average daily rate of consumption for the year.
e Not reported.
f As reported by revised method. For explanation, see Mineral Resources, 1921, Pt. II, p. 284.

CONSUMPTION.

Indicated consumption (deliveries to consumers) of domestic and imported crude petroleum in the United States in 1920 and 1921, by months, in barrels.

Month.	1920	1921	Month.	1920	1921
January	40,876,000	49,534,000	August	47,040,000	42,583,000
February	38,293,000	39,362,000	September	48,367,000	41,702,000
March	42,804,000	45,248,000	October	48,307,000	45,314,000
April	40,954,000	42,562,000	November	48,691,000	45,987,000
May	42,949,000	41,463,000	December	47,835,000	47,905,000
June	41,481,000	42,893,000			
July	42,935,000	41,479,000		530,532,000	526,032,000

IMPORTS AND EXPORTS.

Crude petroleum imported into and exported from the United States, 1917–1921.

Year.	Imports.[a]		Exports.[b]	
	Barrels.	Value.	Barrels.	Value.
1917	30,126,683	$16,255,279	4,098,124	$7,668,312
1918	37,735,641	21,319,464	4,900,691	12,084,250
1919	52,821,567	26,442,881	5,924,320	14,805,546
1920	106,175,289	55,799,254	8,044,907	28,990,444
1921	125,363,983	66,547,379	8,865,497	20,204,491

a Imports of crude petroleum into the United States are chiefly from Mexico, with small quantities from other countries.
b Exports of crude petroleum are chiefly to Canada. Exports of refined products and shipments of crude petroleum to Alaska, Hawaii, Porto Rico, and the Philippine Islands, and foreign petroleum reexported are not included.

PHOSPHATE ROCK.

PRODUCTION.

Phosphate rock sold in the United States, 1916–1921.

Year.	Long tons.	Value.	Year.	Long tons.	Value.
1916	1,982,385	$5,896,993	1919	2,271,983	$11,591,268
1917	2,584,287	7,771,084	1920	4,103,982	25,079,572
1918	2,490,760	8,214,463	1921	2,064,025	12,270,070

IMPORTS AND EXPORTS.

Phosphate rock imported for consumption in the United States, 1916–1921.

Year.	Long tons.	Value.	Year.	Long tons.	Value.
1916	4,612	$36,389	1919	34	$457
1917	92	1,169	1920	63	2,090
1918	.....	.....	1921	3,535	43,960

Phosphate rock marketed in and exported from the United States, 1916–1921.

Year.	Marketed (long tons).	Exported (long tons).	Proportion of exports to total sales (per cent).	Year.	Marketed (long tons).	Exported (long tons).	Proportion of exports to total sales (per cent).
1916	1,982,385	234,678	12	1919	2,271,983	378,731	17
1917	2,584,287	166,358	6	1920	4,103,982	1,069,712	26
1918	2,490,760	143,455	6	1921	2,064,025	733,312	36

PLATINUM AND ALLIED METALS.

PRODUCTION.

Reports received from refiners of platinum, gold bullion, nickel, and copper indicate that 56,370 troy ounces of refined new metals of the platinum group was recovered in 1921, of which about 4,800 ounces is believed to be of domestic origin.

New platinum and allied metals recovered by refiners in the United States, 1917–1921, in troy ounces.

Year.	Platinum.	Iridium.	Osmiridium.	Palladium.	Other.
1917	33,009	210	833	4,779	.....
1918	54,399	465	539	4,024	326
1919	40,220	401	402	3,807	279
1920	36,015	418	409	4,309	393
1921	51,791	286	581	2,686	1,026

Dealers and refiners reported recovery in 1921 of 45,794 ounces of secondary platinum metals derived from refining scrap and sweeps. The figures that make up this total probably represent some duplication, as the same metal may be handled as scrap several times in a year.

Secondary platinum and allied metals recovered in the United States, 1917–1921, in troy ounces.

Year.	Platinum.	Iridium.	Palladium.
1917	59,007	9,832	3,347
1918	40,378	3,410	1,795
1919	54,545	3,504	3,467
1920	51,255	3,355	3,100
1921	39,131	1,776	4,887

IMPORTS AND EXPORTS.

Platinum and allied metals imported for consumption in the United States, 1920–1921.

Metal.	1920		1921	
	Troy ounces.	Value.	Troy ounces.	Value.
Platinum or crude platinum and unmanufactured products, ingots, bars, sheets, wire	80,955	$8,474,499	61,941	$4,115,235
Platinum, manufactured products, vases, retorts, etc	781	[a] 94,408	219	[a] 28,524
Iridium	4,718	726,502	1,345	277,597
Osmiridium	4,473	450,241	2,603	296,277
Osmium	593	39,517	161	13,239
Palladium	6,944	612,248	11,348	629,965
Rhodium	2,053	217,385	609	53,359
Ruthenium	29	2,640	152	4,268
	100,546	10,617,440	78,378	5,418,464

[a] Includes articles to the value of $15,711 in 1920 and $21,351 in 1921, imported under duty, quantity not given.

Platinum exported from the United States, 1917–1921.

Year.	Domestic.			Foreign manufactures, (ingots, bars, etc.).	
	Unmanufactured.		Manufactures.		
	Troy ounces.	Value.		Troy ounces.	Value.
1917	3,445	$234,433	$65,415	11	$1,200
1918	119	13,511	23,562	.....	.....
1919	522	75,066	54,529	.....	.....
1920	1,302	177,115	111,014	.....	.....
1921	3,272	244,473	85,216	.....	.....

POTASH.

PRODUCTION.

Potash produced and sold in the United States in 1917–1921.

Year.	Produced.			Sold.		
	Number of plants.	Crude potash (short tons).	Available content of potash (K_2O) (short tons).	Crude potash (short tons).	Available content of potash (K_2O) (short tons).	Value.
1917	95	[a] 126,961	32,573	[a] 126,961	32,573	$13,980,577
1918	128	207,686	54,803	140,343	38,580	15,839,618
1919	102	116,634	32,474	166,063	45,728	11,271,269
1920	66	166,834	48,077	139,963	41,444	7,463,026
1921	20	25,485	10,171	10,337	4,408	447,859

[a] Production and sales were practically the same in 1917, and no distinction was made between them.

Potash produced and sold in the United States in 1920 and 1921, by sources.

Source.	Produced.				Sold.[a]		
	Number of plants.	Crude potash (short tons).	Available content of potash (K_2O).		Crude potash (short tons).	Available content of potash (K_2O) (short tons).	Value f. o. b. plant.
			Short tons.	Percentage of total.			
1920.							
Mineral:							
Natural brines—							
Nebraska lakes	11	85,245	20,934	43.5	79,872	19,628	$3,755,084
Other brines	6	45,438	16,581	34.5	30,186	13,058	1,770,374
	17	130,683	37,515	78.0	110,058	32,686	5,525,458
Alunite and silicate rocks	3	4,311	2,127	4.4	4,018	2,006	457,576
Dust from cement mills	8	10,168	1,147	2.4	9,334	840	175,279
Dust from blast furnaces	9	2,203	173	.4	1,126	106	16,240
Organic:							
Molasses distillery waste and kelp	5	9,830	3,458	7.2	9,140	3,233	654,139
Steffens waste water from beet-sugar refineries	7	9,201	3,394	7.1	5,904	2,343	496,480
Wood ashes	17	438	263	.5	383	230	137,854
	66	166,834	48,077	100.0	139,963	41,444	7,463,026
1921.							
Mineral:							
Natural brines	7	11,907	6,057	59.6	6,376	3,078	281,630
Dust from cement mills	3	3,366	1,037	10.2	[b] 256	82	12,923
Dust from blast furnaces	5	1,257	106	1.0	580	50	5,018
Organic:							
Molasses distillery waste, Steffens waste water from beet-sugar refineries, and wood ashes	5	8,955	2,971	29.2	3,125	1,198	148,288
	20	25,485	10,171	100.0	10,337	4,408	447,859

[a] Sales were made and stocks reported on hand by a number of companies that did not report production in 1921.
[b] Includes potash from alunite.

Potash produced in the United States in 1920 and 1921, by States.

State.	Number of plants.	Crude potash (short tons).	Available content of potash (K_2O).	
			Short tons.	Percentage of total.
1920.				
Nebraska	12	87,100	21,804	45.4
California [a]	11	30,868	12,234	25.4
Utah [b]	6	34,905	10,069	20.9
Colorado	3	4,095	1,683	3.5
Wisconsin	10	345	207	.9
Pennsylvania	10	2,256	176	
Michigan	7	93	56	
Other States [c]	7	7,172	1,848	3.9
	66	166,834	48,077	100.0
1921.				
California	6	13,075	6,187	61
Pennsylvania	5	1,257	106	1
Other States [c]	9	11,153	3,878	38
	20	25,485	10,171	100

[a] Some of the material utilized in a California plant was produced in Hawaii.
[b] Some of the material produced in Utah was utilized in a Virginia manufacturing plant.
[c] 1920: Two plants in Maryland, and one each in Missouri, New York, Ohio, Porto Rico, and Wyoming; 1921: Two plants in Nebraska, two in Utah, and one each in Indiana, Maryland, New York, Tennessee, and Wisconsin.

STOCKS.

Potash held by producers in the United States, December 31, 1920 and 1921, in short tons.

Source.	1920		1921	
	Crude potash.	Available content of potash (K_2O).	Crude potash.	Available content of potash (K_2O).
Mineral:				
Natural brines—				
Nebraska lakes	5,436	1,318	18,763	8,194
Other sources	21,081	5,869		
	26,517	7,187	18,763	8,194
Silicate rocks	315	132		
Alunite				
Dust from cement mills	864	300	3,745	1,259
Dust from blast furnaces	1,207	75	1,200	115
Organic:				
Kelp	940	315		
Molasses distillery waste				
Steffens waste water from beet-sugar refineries	2,475	953	9,217	3,057
Wood ashes	60	37		
	32,378	8,999	32,925	12,625

IMPORTS AND EXPORTS.

Potash materials imported and entered for consumption in the United States, 1917–1921.

Year.	Potash salts used mainly in the fertilizer industry.[a]			Potash salts used mainly in chemical industries.[b]			Total.		
	Short tons.		Value.	Short tons.		Value.	Short tons.		Value.
	Gross weight.	Potash (K_2O) content.		Gross weight.	Potash (K_2O) content.		Gross weight.	Potash (K_2O) content.	
1917	1,165	504	$189,159	24,122	7,596	$7,599,247	25,287	8,100	$7,788,406
1918	525	261	117,438	23,894	7,696	8,790,398	24,419	7,957	8,907,836
1919	127,416	28,484	4,163,739	33,430	11,135	6,028,077	160,846	39,619	10,191,816
1920	918,698	197,795	33,885,627	63,564	26,997	9,504,156	982,262	224,792	43,389,783
1921	212,752	64,126	7,743,364	32,453	14,572	3,739,090	245,205	78,698	11,482,454

[a] Includes kainite, manure salts, muriate, and sulphate. Considerable quantities of muriate and some sulphate were used in chemical industries.

[b] Includes bicarbonate, bichromate, bitartrate, carbonate, caustic, chlorate, chromate, cyanide, ferricyanide, ferrocyanide, iodide, nitrate, permanganate, and Rochelle salt.

Domestic potash salts exported from the United States, 1920 and 1921.

Material.	1920			1921		
	Short tons.		Value.	Short tons.		Value.
	Gross weight.	Potash. (K_2O) content.		Gross weight.	Potash (K_2O) content.	
Potassium chlorate	1,410	535	$445,243	188	71	$49,709
All other potassium salts			3,116,772			286,284
			3,562,015			335,993

PUMICE.

[See Abrasive materials.]

PYRITES.

PRODUCTION.

Pyrites produced in the United States, 1916–1921.

Year.	Long tons.	Value.	Year.	Long tons.	Value.
1916	439,132	$2,038,602	1919	420,647	$2,558,172
1917	482,662	2,593,035	1920	310,777	1,596,961
1918	464,494	2,644,515	1921	157,118	711,432

IMPORTS.

Pyrites containing more than 25 per cent of sulphur imported for consumption in the United States, 1916–1921.

Year.	Long tons.	Value.	Year.	Long tons.	Value.
1916	1,244,662	$6,728,318	1919	388,973	$2,176,565
1917	967,340	5,981,457	1920	332,606	1,660,832
1918	496,792	2,741,676	1921	216,229	818,852

No exports of pyrites are reported.

QUICKSILVER.

SUPPLY.

Supplies of quicksilver in the United States, 1917–1921.

[Flasks of 75 pounds.]

Year.	Production.		Imports for consumption.		Exports.		Apparent consumption.[a]	
	Flasks.	Value.	Flasks.	Value.	Flasks.	Value.	Flasks.	Value.
1917	36,159	$3,808,266	5,207	$448,032	10,778	$998,470	30,588	$3,257,828
1918	32,883	3,863,752	6,719	533,622	3,098	338,620	36,504	4,058,754
1919	21,415	1,933,560	10,635	791,226	9,107	817,328	22,943	1,907,458
1920	13,392	1,066,807	14,169	971,510	1,553	129,993	26,008	1,908,324
1921	6,339	300,595	10,601	457,993	393	18,869	16,547	739,719

[a] Production plus imports minus exports.

PRODUCTION.

Quicksilver produced in the United States, 1919–1921, by States.

State.	1919		1920		1921	
	Flasks.	Value.	Flasks.	Value.	Flasks.	Value.
California	15,205	$1,372,859	9,849	$784,571	3,055	$144,868
Texas	5,019	453,166	3,436	273,712		
Oregon	435	39,276	24	1,912	3,284	155,727
Nevada	756	68,259	83	6,612		
Idaho						
	21,415	1,933,560	13,392	1,066,807	6,339	300,595

PRICES.

Average yearly prices of quicksilver, per flask, in the United States and the United Kingdom, 1916–1921.

Year.	San Francisco [a] (domestic).	New York.[b]	London.[c]	Year.	San Francisco [a] (domestic).	New York.[b]	London.[c]
			£ s. d.				£ s. d.
1916	$125.89	$125.49	17 2 10	1919	$90.29	$92.15	20 9 5½
1917	105.32	106.30	22 4 3	1920	79.66	81.12	20 14 9
1918	117.50	123.47	(d)	1921	47.42	45.46	11 3 5

[a] Min. and Sci. Press, San Francisco.
[b] Eng. and Min. Jour., New York.
[c] Min. Jour. (London).
[d] Quoted as "nominal" only

RADIUM.

[See Uranium and vanadium ores.]

SALT.

SUPPLY.

Supplies of salt for consumption in the United States, 1900, 1910, and 1920–1921, in short tons.

	1900	1910	1920	1921
Domestic production	2,921,708	4,242,792	6,840,029	4,981,154
Imports	199,909	137,103	137,654	93,095
Total supply	3,121,617	4,379,895	6,977,683	5,074,249
Exports	7,511	49,013	139,272	109,563
Domestic consumption	3,114,106	4,330,882	6,838,411	4,964,686
Comparison with preceding year	+178,449	+6,444	+15,411	−1,873,725
Percentage of imports to total consumption	6.4	3.2	2.0	1.9

PRODUCTION.

Domestic salt marketed in the United States, 1917–1921.

Year.	Short tons.				Total value.	Average value.
	Manufactured (evaporated).	In brine.	Rock salt.	Total.		
1917	2,482,564	2,890,588	1,605,025	6,978,177	$19,940,442	$2.86
1918	2,724,203	2,830,600	1,683,941	7,238,744	26,940,361	3.72
1919	2,392,290	2,850,639	1,639,973	6,882,902	27,074,694	3.93
1920	2,409,924	2,819,916	1,610,189	6,840,029	29,894,075	4.37
1921	1,931,243	1,577,335	1,472,576	4,981,154	24,557,966	4.93

SAND AND GRAVEL.

PRODUCTION.

Sand and gravel produced and sold in the United States, 1917–1921.

Year.	Glass sand.		Molding sand.		Building sand.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	1,942,675	$2,685,014	4,660,968	$4,303,809	25,374,987	$9,837,688
1918	2,172,887	4,209,728	4,910,178	5,121,865	19,686,885	9,772,556
1919	1,827,409	3,593,371	3,774,612	4,153,990	21,969,736	12,296,664
1920	2,165,926	4,748,690	5,128,075	7,504,759	26,539,365	17,956,635
1921	1,280,359	2,314,314	1,906,977	2,451,966	24,565,605	16,151,792

Year.	Other sand.		Gravel.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	8,866,876	$4,962,232	35,573,819	$13,508,189	76,419,325	$35,296,932
1918	6,349,870	5,259,620	28,704,606	13,563,310	61,824,426	37,927,079
1919	8,397,979	6,345,654	34,606,671	19,561,877	70,576,407	45,951,556
1920	9,942,776	8,988,530	38,265,246	26,462,991	82,041,388	65,661,605
1921	10,542,013	8,230,257	41,550,054	27,434,295	79,845,008	56,582,624

IMPORTS AND EXPORTS.

Value of sand and gravel imported into and exported from the United States, 1916–1921.

Year.	Imports.	Exports.	Year.	Imports.	Exports.
1916	$87,144	$233,310	1919	$126,586	$382,070
1917	142,586	494,251	1920	912,282	669,945
1918	91,465	619,414	1921	771,734	379,982

[a] These imports and exports are mostly building sand shipped from and to Canada.

SAND-LIME BRICK.

PRODUCTION.

Sand-lime brick sold in the United States, 1916–1921.

Year.	Number of operators.	Thousands.	Value.	Year.	Number of operators.	Thousands.	Value.
1916	53	227,344	$1,474,073	1919	35	146,947	$1,705,163
1917	47	187,546	1,420,330	1920	37	169,761	2,490,283
1918	42	98,399	883,929	1921[a]	27	93,105	1,216,077

[a] According to the Bureau of the Census.

IMPORTS AND EXPORTS.

Imports and exports of sand-lime brick are not reported separately.

SELENIUM.

PRODUCTION.

The output of selenium in 1921 from the American Smelting & Refining Co., the Raritan Copper Works, and the United States Metals Refining Co. was largely consumed by chemical and glass manufacturers. Most of the selenium produced is a by-product in the electrolytic refining of copper.

Selenium produced in the United States and sold, 1917–1921.

Year	Pounds.	Value.	Year.	Pounds.	Value.
1917	39,630	$70,000	1920	92,141	$175,508
1918	103,694	206,540	1921	55,978	89,148
1919	60,025	125,966			

IMPORTS.

Selenium and selenium salts imported for consumption in the United States, 1916–1921.

1916	$302	1919	$25,866
1917	2,236	1920	...
1918		1921	2,099

SILICA BRICK.

Silica brick sold in the United States, 1916–1921.

Year.	Thousands.	Value.	Average value.	Year.	Thousands.	Value.	Average value.
1916	232,673	$6,369,256	$27.37	1919	211,420	$10,914,898	$51.63
1917	327,030	15,510,595	47.43	1920	250,582	15,076,821	60.17
1918	336,562	19,987,803	59.39	1921 [a]	104,923	5,218,207	49.73

[a] According to the Bureau of the Census.

Imports and exports of silica brick are not reported separately.

SILICA

Silica sold for pottery, paints, fillers, polishers, abrasives, and other uses in the United States, 1919–1921.

Material.	1919		1920		1921	
	Short tons.	Value	Short tons	Value.	Short tons.	Value.
Quartz (vein quartz, pegmatite, and quartzite)	63,332	$373,571	68,190	$320,350	11,252	$81,937
Sand and sandstone [a]	47,277	288,890	158,395	1,183,014	105,887	802,450
Tripoli (ground and otherwise prepared)	24,292	181,541	40,233	569,677	12,340	213,013
Diatomaceous earth	42,642	531,960	61,922	1,079,693	[b] 55,134	[b] 682,616
	177,543	1,375,962	328,740	3,152,734	184,613	1,783,036

[a] Includes only finely ground material. Figures probably incomplete. [b] Partly estimate.

No imports or exports of silica (quartz) are reported.

SILVER.

[See under Gold and silver.]

SLATE.

PRODUCTION.

Slate sold in the United States, 1917–1921, by uses.

Year.	Roofing slate.			Mill stock.			Slate for other uses.[a]	Total value.
	Number of squares (100 sq. ft).	Value.	Average value.	Square feet.	Value.	Average value.		
1917	703,667	$3,411,740	$4.85	10,663,000	$1,799,917	$0.17	$538,309	$5,749,966
1918	379,817	2,219,131	5.84	7,204,000	1,853,603	.26	768,386	4,841,120
1919	454,337	3,085,957	6.79	7,466,000	1,782,793	.24	1,161,898	6,030,648
1920	396,230	3,524,658	8.90	9,910,000	3,147,281	.32	2,054,503	8,726,442
1921	348,085	3,197,745	9.19	8,970,000	2,719,723	.30	1,404,538	7,322,006

[a] Chiefly slate granules.

Value of slate sold in United States, 1917–1921, by States.

State.	1917	1918	1919	1920	1921
California	(a)	(a)			
Georgia					(a)
Maine	$322,685	$287,891	$279,274	$450,561	$409,303
Maryland	67,938	42,113	71,593	80,789	(a)
New Jersey	(a)	(a)			(a)
New York	55,207	323,558	450,379	911,293	516,956
Pennsylvania	3,306,704	2,304,647	2,885,072	3,850,267	3,595,386
Tennessee	(a)	(a)			(a)
Utah	(a)	175	400		
Vermont	1,858,307	1,769,987	2,143,648	3,182,477	2,346,978
Virginia	135,380	109,723	200,282	251,055	212,943
Undistributed [b]	3,745	3,026			240,440
	5,749,966	4,841,120	6,030,648	8,726,442	7,322,006

[a] Included under "Undistributed."
[b] 1917: California, New Jersey, Tennessee, and Utah; 1918: California, New Jersey, and Tennessee; 1921: Georgia, Maryland, New Jersey, and Tennessee.

Roofing slate, mill stock, and slate granules sold in 1920 and 1921, by uses.

Use.	1920			1921		
	Quantity.	Value.	Average value.	Quantity.	Value.	Average value.
Roofing.....squares	396,230	$3,524,658	$8.90	348,085	$3,197,745	$9.19
Approximate equivalent in short tons	134,000			117,500		
Electrical.....square feet	1,950,397	1,491,769	.76	1,173,653	927,951	.79
Approximate equivalent in short tons	10,700			8,400		
Structural and sanitary..square feet	2,593,563	916,216	.35	1,706,321	642,532	.38
Approximate equivalent in short tons	19,500			12,300		
Grave vaults and covers..square feet	477,239	130,795	.27	552,592	121,967	.22
Approximate equivalent in short tons	6,800			8,000		
Blackboards and bulletin boards .....square feet	2,254,876	385,480	.17	3,154,201	791,241	.25
Approximate equivalent in short tons	16,200			22,600		
Billiard table tops.....square feet	344,258	140,032	.41	462,920	179,862	.39
Approximate equivalent in short tons	2,500			3,300		
School slates.....pieces	4,302,390	82,989	[a] 19.29	3,591,376	56,170	[a] 15.64
Approximate equivalent in square feet	2,290,000			1,921,000		
Approximate equivalent in short tons	4,000			2,500		
Granules.....short tons	268,516	2,044,942	7.62	231,770	1,397,886	6.03
Other.....short tons (estimated)	6,500	9,561		5,130	6,652	
Total (quantities approximate, in short tons)	468,700	8,726,442		411,500	7,322,006	

[a] Average value per thousand pieces

IMPORTS AND EXPORTS.

Value of slate imported for consumption in the United States, 1916–1921.

1916	$2,200	1919	$691
1917	1,024	1920	4,512
1918	321	1921	2,923

Value of roofing slate exported from the United States, 1916–1921.

1916	$27,630	1919	$55,164
1917	27,113	1920	122,105
1918	65,224	1921	101,630

The following figures for exports of slate other than roofing were collected by the United States Geological Survey from shippers of the products named.

Slate other than roofing exported from the United States, 1919–1921, by uses.

Use.	1919		1920		1921	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
School slates.....cases[a]..	13,763	$137,411	34,231	$321,290	17,463	$201,383
Electrical slate....square feet..	41,485	26,991	54,038	44,248	55,459	53,505
Blackboards.....do....	34,841	7,605	32,322	10,726	155,551	52,598
Billiard tables.....do....	11,512	3,884			68,167	35,686
Structural.....do....			(b)	(b)	2,613	1,310
	.....	175,891	.....	376,264	.....	344,482

[a] Cases weigh from 130 to 165 pounds each; average is 135 pounds.
[b] Statistics not collected for 1920.

SOAPSTONE.

[See Talc and soapstone.]

SODIUM COMPOUNDS.

PRODUCTION.

Domestic sodium compounds sold in the United States, 1917–1921.[a]

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1917	10,123,322	$130,694,458	1920	9,774,289	$138,607,384
1918	9,997,310	134,594,154	1921	(b)	(b)
1919	9,166,581	118,836,347			

[a] The approximate constancy in these figures from year to year is due in large part to the inclusion of sodium chloride, the fundamental sodium compound from which most of the others are made.
[b] Canvass for sodium compounds for 1921 (except for those derived from natural sources, shown in second table following) conducted by Bureau of the Census. Canvass discontinued by Geological Survey.

Sodium compounds produced and sold in the United States in 1919 and 1920, by varieties.

Product.	1919		1920	
	Short tons.	Value.	Short tons.	Value.
Sodium acetate	823	$121,167	1,080	$149,287
Sodium benzoate	126	230,224	201	365,841
Sodium bicarbonate	134,962	3,486,635	188,906	4,256,715
Sodium bichromate	26,526	6,233,566	25,973	5,531,954
Sodium bisulphite	[a]11,819	[a]687,750	22,059	1,028,373
Sodium bromide	499	493,319	543	523,724
Sodium carbonate:				
Soda ash	981,054	29,895,343	1,238,149	38,908,726
Monohydrate	31,278	714,930	2,267	115,256
Trona			10,609	343,911
Sal soda	80,090	2,229,994	62,857	2,128,937
Sodium chloride (common salt):				
Salt in brine	2,850,639	1,423,424	2,819,916	1,834,397
Rock salt	1,639,973	6,224,920	1,610,189	7,048,315
Evaporated salt	2,392,290	19,426,350	2,409,924	21,011,363
Sodium citrate, tartrate, and bitartrate	33	58,128	44	67,115
Sodium cyanide, peroxide, and nitrate (refined)	17,188	5,331,123	8,633	3,415,085
Sodium ferrocyanide	3,437	1,346,285	2,930	1,318,049
Sodium fluoride	674	168,960	934	210,782
Sodium fluosilicate	[b]	[b]	719	143,800
Sodium hydroxide	311,388	20,091,978	382,680	25,894,641
Sodium iodide	12	86,985	11	76,441
Sodium nitrite	1,182	265,121	1,197	405,184
Sodium phosphate	14,760	1,733,996	30,515	3,233,896
Sodium silicate	300,138	5,879,628	304,503	5,751,088
Sodium sulphate:				
Salt cake	129,042	2,019,460	178,770	2,049,102
Glauber's salt	47,730	877,060	50,655	990,541
Niter cake	83,402	271,424	308,638	788,544
Sodium sulphide	45,448	2,645,181	42,952	2,962,033
Sodium sulphite	[a]	[a]	3,778	197,782
Sodium tetraborate (borax)	28,518	4,351,891	35,281	5,674,012
Sodium thiosulphate	32,212	1,709,223	24,868	1,290,697
Miscellaneous sodium compounds	1,338	832,282	4,508	891,793
	9,166,581	118,836,347	9,774,289	138,607,384

[a] Sodium sulphite included under "Sodium bisulphite" for 1919.
[b] Included under "Miscellaneous sodium compounds."

Sodium salts derived from natural sources in the United States, 1920 and 1921, by varieties.

Salt.	1920		1921	
	Short tons.	Value.	Short tons.	Value.
Sodium chloride (common salt):				
Salt in brine	2,819,916	$1,834,397	1,577,335	$1,017,080
Rock salt	1,610,189	7,048,315	1,472,576	6,693,923
Evaporated salt	2,409,924	21,011,363	1,931,243	16,846,963
Sodium carbonate, bicarbonate, sulphate, trona, and borax	42,683	1,513,179	25,000	894,000
	6,882,712	31,407,254	5,006,154	25,451,966

Crude borates produced in the United States, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	103,525	$2,409,459	1919[a]	66,146	$1,380,000
1917	108,875	3,609,632	1920[a]	120,320	2,173,000
1918	88,794	2,263,230	1921[a]	50,000	1,600,000

[a] Includes naturally occurring borax.

IMPORTS AND EXPORTS.

Sodium salts imported for consumption in the United States, 1920 and 1921, by varieties.

Salt.	1920		1921	
	Pounds.	Value.	Pounds.	Value.
Sodium arsenate	15,976	$1,481	127,537	$11,613
Sodium benzoate	33	17	12,121	12,983
Sodium bicarbonate [a]	5,828	593	293,060	4,850
Sodium carbonate:				
Soda ash	1,515,278	37,161	20,344,935	269,720
Monohydrate and sesquicarbonate	3,342	106	71,632	2,220
Sal soda	4,796	577	68,779	1,652
Sodium chlorate	561,513	50,266	659,342	33,456
Sodium chloride (common salt)	275,308,200	676,499	186,190,200	531,031
Sodium chromate and sodium bichromate			64,236	5,308
Sodium cyanide	7,590,495	1,091,443	8,707,537	913,091
Sodium ferrocyanide (yellow prussiate of sodium)	2,201,662	400,873	2,510,848	308,395
Sodium hydroxide, or caustic soda	97,798	11,970	1,401,211	62,671
Sodium nitrate, or Chilean nitrate	2,961,038,080	63,121,035	849,347,520	17,982,977
Sodium nitrite	11,690,142	1,378,992	3,174,642	238,083
Sodium phosphate	66	19	1,274,938	33,464
Sodium silicate	658,658	15,162	858,146	26,311
Sodium sulphate, crude, or salt cake, and niter cake	230,720	2,833	369,600	4,643
Sodium sulphate crystals, or Glauber's salt	2,240	36	6,213,760	27,179
Sodium sulphide	1,038,181	47,064	5,417,921	153,031
Sodium sulphite	119,805	5,388	1,112,685	33,879
Sodium tetraborate, or refined borax	30,563	2,451	226,240	12,477
Sodium thiosulphate, or sodium hyposulphite	17,174	11,989	894,074	12,229
	3,262,130,550	66,855,955	1,089,340,964	20,681,263

[a] Or supercarbonate, or saleratus, and other salts containing 50 per cent or more of sodium bicarbonate.

Domestic sodium salts exported from the United States, 1916–1921.

1916	$17,571,439	1919	$18,545,420
1917	23,384,969	1920	27,191,439
1918	22,291,735	1921	7,921,315

Domestic sodium salts exported from the United States, 1920 and 1921, by varieties.

Salt.	1920		1921	
	Short tons.	Value.	Short tons.	Value.
Sodium bicarbonate	10,321	$616,261	5,852	$307,138
Sodium carbonate:				
Soda ash	83,381	4,689,591	17,521	856,369
Sal soda	6,015	220,487	5,177	204,616
Sodium chloride (common salt)	139,272	1,901,593	109,563	1,415,471
Sodium hydroxide	112,069	10,944,017	24,933	2,041,236
Sodium silicate	17,048	450,770	10,395	247,761
Sodium tetraborate (borax)	7,163	1,206,936	2,031	269,771
All other sodium salts		7,161,784		2,584,953
		27,191,439		7,921,315

Foreign sodium salts reexported from the United States, 1917–1921.

Year.	Sodium chloride (common salt).		Sodium cyanide.		Sodium nitrate.		All other sodium salts.
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	
1917	1,900	$21,830	138	$115,067	78,152	$5,367,281	$25,632
1918	723	13,903	(a)	145	61,271	5,204,413	73,402
1919	457	7,992			15,314	1,299,563	388,943
1920	417	6,252	78	12,123	22,197	1,448,226	98,386
1921	651	5,969	703	117,258	37,033	2,011,109	27,224

[a] 125 pounds.

STEEL.

[See Iron ore, pig iron and steel.]

STONE.

PRODUCTION.

Stone produced and sold in the United States, 1917–1921, by varieties.

Year.	Granite.		Basalt and related rocks (trap rock).		Sandstone.		Marble.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	5,564,200	$15,544,957	9,103,580	$7,570,885	3,880,500	$5,512,421	310,130	$6,330,387
1918	3,827,400	14,466,423	6,859,200	7,782,280	2,858,100	4,529,298	305,720	5,496,389
1919	4,221,220	19,345,714	7,410,770	8,944,686	2,623,270	5,283,842	333,400	8,042,297
1920	4,760,000	24,954,908	9,219,200	12,260,148	3,343,000	7,310,290	431,500	11,069,585
1921	4,752,180	20,592,217	8,524,480	11,450,899	2,640,460	6,425,339	315,400	8,580,416

Year.	Limestone.		Other stone.[a]		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	63,481,500	$46,263,379	1,234,990	$993,642	83,574,900	$82,215,671
1918	53,868,200	49,453,006	844,740	973,034	68,563,360	82,700,430
1919	49,759,800	53,171,701	1,190,540	1,920,903	65,539,000	96,709,143
1920	59,290,000	75,655,260	1,483,300	2,291,769	78,527,000	133,541,960
1921	45,621,000	57,749,594	1,685,220	2,163,801	63,538,740	106,962,266

[a] Includes mica schist used for furnace lining, conglomerate, argillite, and various light volcanic rocks used mainly for crushed stone, which can not be properly classified in any of the main groups.

Stone sold in the United States in 1920 and 1921.

Use.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Building stone, cubic feet	15,870,530	$18,948,588	17,006,210	$18,975,819
Approximate equivalent in short tons	1,266,380		1,368,650	
Monumental stone, cubic feet	4,549,430	17,488,765	2,772,000	10,353,105
Approximate equivalent in short tons	383,910		230,000	
Paving blocks, number	35,959,200	2,898,459	41,588,860	3,593,373
Approximate equivalent in short tons	389,980		453,130	
Curbing, cubic feet	1,508,480	1,297,058	2,255,770	1,859,926
Approximate equivalent in short tons	127,710		183,600	
Flagging, cubic feet	688,890	463,718	791,660	471,837
Approximate equivalent in short tons	56,460		65,100	
Rubble, short tons	501,570	791,177	445,210	601,208
Riprap, do	2,211,170	2,431,723	1,813,590	1,694,206
Crushed stone, do	40,365,860	50,846,693	43,202,840	51,717,478
Furnace flux (limestone and marble), long tons	22,402,100	26,635,977	9,525,900	9,457,946
Equivalent in short tons	25,090,350		10,669,000	
Refractory stone[a], short tons	1,735,440	2,393,537	496,150	643,638
Manufacturing industries (limestone and marble), short tons	4,592,280	4,591,559	2,883,090	3,801,162
Other uses[b], do	1,805,890	4,754,706	1,728,380	3,792,568
Total (quantities approximate, in short tons)	78,527,000	133,541,960	63,538,740	106,962,266

[a] Ganister, mica schist, and dolomite.

[b] Chiefly agricultural limestone.

IMPORTS AND EXPORTS.

Stone imported for consumption in the United States, 1919–1921.

Kind.	1919		1920		1921	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Marble:						
In blocks, rough, etc.....cubic feet..	209,945	$593,340	468,845	$1,238,192	388,731	$810,850
Sawed.....do....	9	90	102	922	(a)	105
Slabs or paving tiles...square feet..	104,102	25,841	49,013	27,097	112,470	44,333
All other manufactures.....	.....	46,622	.....	83,768	.....	103,273
Mosaic cubes of marble or onyx:						
Loose.....	.....	3,888	.....	18,221	.....	30,865
Attached to paper.....	.....	974	.....	63	.....	581
	.....	670,755	.....	1,388,263	.....	990,007
Onyx:						
In blocks, rough, etc.....cubic feet..	2,040	9,517	6,395	36,840	1,010	4,115
Slabs or paving tiles....square feet..	.....	.....	4,200	4,009	10,470	3,832
All other manufactures.....	.....	2,053	.....	2,960	.....	9,990
	.....	11,570	.....	43,809	.....	17,937
Granite:						
Dressed.....	.....	9,983	.....	108,193	.....	108,219
Rough.....cubic feet..	23,240	17,796	43,805	42,162	32,525	27,258
	.....	27,779	.....	150,355	.....	135,477
Stone (other):						
Dressed.....	.....	21,444	.....	17,622	.....	30,419
Rough (monumental or building stone).....cubic feet..	13,807	14,228	110,940	98,327	53,116	54,181
Rough (other).....	.....	42,185	.....	97,199	.....	25,938
	.....	77,857	.....	213,148	.....	110,538
Grand total.....	.....	787,961	.....	1,795,575	.....	1,253,959

[a] Quantity not given.

Value of stone exported from the United States, 1917–1921.

Kind.	1917	1918	1919	1920	1921
Marble and stone, unmanufactured.....	$572,097	$552,261	$770,392	$774,442	$576,905
All other, manufactured.....	1,108,185	1,208,164	1,508,997	2,158,764	1,697,570
	1,680,282	1,760,425	2,279,389	2,933,206	2,274,475

STRONTIUM.

PRODUCTION.

Domestic strontium ore marketed in the United States, 1916–1918.[a]

Year.	Short tons.	Value.
1916.....	250	$3,650
1917.....	4,035	87,700
1918.....	400	20,000

[a] The Geological Survey has no record of the production of domestic strontium ore prior to 1916, and no production has been reported since 1918.

IMPORTS.

It is estimated that an average of 2,000 short tons of strontium ore has been imported annually for domestic consumption in recent years. In 1920 the quantity of imported ore used by manufacturers was apparently considerably greater than this, but in 1921 it was apparently less than 600 tons. No record of the importation of strontium ore is kept at customs offices.

Value of strontium carbonate and strontium oxide imported for consumption in the United States, 1916–1921.

1916	$11,049	1919	$3,380
1917	23,216	1920	15,479
1918	2,459	1921	4,393

No exports of strontium ore have been reported.

SULPHUR.

PRODUCTION.

Sulphur produced and shipped in the United States, 1916–1921.

Year.	Mined (long tons).	Shipped.		Year.	Mined (long tons).	Shipped.	
		Long tons.	Approximate value.			Long tons.	Approximate value.
1916	649,683	766,835	$12,246,000	1919	1,190,575	678,257	$10,252,000
1917	1,134,412	1,120,378	23,987,000	1920	1,255,249	1,517,625	30,000,000
1918	1,353,525	1,266,709	27,868,000	1921	1,879,150	954,344	17,000,000

IMPORTS AND EXPORTS.

Sulphur imported and entered for consumption in the United States, 1917–1921.

Year.	Crude.		Refined.		All other.[a]		Total.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
1917	973	$20,176	.....	.....	42	$9,164	1,015	$29,340
1918	55	1,692	.....	.....	27	7,850	82	9,542
1919	77	1,997	.....	$15	24	6,621	101	8,633
1920	44	1,722	50	2,530	42	22,576	136	26,828
1921	4	226	35	2,311	11	3,341	50	5,878

[a] Includes sulphur lac, flowers of sulphur, and other grades not otherwise provided for, but not pyrite.

Sulphur exported from the United States, 1916–1921.

Year.	Long tons.	Value.	Year.	Long tons.	Value.
1916	128,755	$2,505,857	1919	224,712	$6,325,552
1917	152,736	3,500,819	1920	477,450	8,994,350
1918	131,092	3,626,638	1921	285,762	4,524,768

TALC AND SOAPSTONE.

PRODUCTION.

Domestic talc ana soapstone sold in the United States, 1917–1921, by classes.

Year.	Crude.		Sawed and manufactured.				Ground.		Total.	
			Talc.		Soapstone.					
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	12,619	$69,140	5,781	$176,404	19,885	$402,506	180,563	$1,644,828	218,848	$2,292,878
1918	17,633	193,278	1,075	116,952	12,330	501,059	177,269	1,869,730	208,307	2,681,019
1919	15,625	73,437	921	147,339	16,504	530,163	151,793	1,601,736	184,843	2,352,675
1920	11,008	43,820	1,415	139,335	19,707	709,400	178,505	2,142,894	210,635	3,035,449
1921	2,150	12,911	(a)	(a)	a17,423	a627,826	106,861	1,180,714	126,434	1,821,451

a Talc included under "Soapstone."

IMPORTS AND EXPORTS.

Talc imported for consumption in the United States, 1917–1921.

Year.	Crude and unground steatite and French chalk.a			Talc, steatite, and French chalk—cut, ground, or washed.b			Total.	
	Short tons.	Value.	Average value.	Short tons.	Value.	Average value.	Short tons.	Value.
1917	2,452	$10,710	$4.37	16,157	$258,787	$16.02	18,609	$269,497
1918	1,434	9,253	6.45	12,735	251,323	19.73	14,169	260,576
1919	1,641	10,105	6.16	12,961	248,899	19.20	14,602	259,004
1920	941	7,206	7.57	21,739	443,514	20.40	22,680	450,720
1921	153	2,279	14.90	11,468	239,469	20.88	11,621	241,748

a Duty free. b 15 per cent duty.

No material that might be classed as soapstone is imported. Exports of talc and soapstone are not separately classified.

TANTALUM.

In 1918 the demand for tantalum and columbium salts for experimental purposes became large enough to allow A. T. Roos, of Deadwood, S. Dak., to market 4,500 pounds of columbite, valued at $2,250. In 1919 only 300 pounds, valued at $90, was shipped. In 1920, Dr. Roos sold for $1,450 approximately 4,000 pounds of columbite guaranteed to contain 70 per cent of the combined oxides Ta_2O_5 and Cb_2O_5. The ore was all or nearly all made into ferrotantalum-columbium, with no attempt to separate the tantalum and columbium. The ferro was used for experimental purposes. In 1921 Dr. Roos shipped 3,400 pounds of columbite, valued at $1,150, from the pegmatites near Keystone and Hill City, S. Dak.

In 1921, 6,785 pounds of "tantalum steel-hardening ores," valued at $1,327, was imported. Under the heading "Tantalum" 1,229 pounds of material, valued at $788, was imported in 1921. From

the value given it seems probable that this material was tantalum ore. No tantalum or "tantalum steel-hardening ores" were imported in 1920, and no separate record of exports is kept.

TELLURIUM.

Tellurium is recovered from tank slimes obtained in the electrolytic refining of copper and lead. It has been hitherto considered a waste by-product and an objectionable impurity in the commercial metal. A noteworthy development of the year was the discovery that the addition of diethyl telluride to motor gasoline gives increased mileage. The Raritan Copper Works and the United States Metals Refining Co. reported production of tellurium in 1921. The lead refineries of the U. S. Smelting, Refining & Mining Co. at East Chicago, Ind., and the American Smelting & Refining Co. at Omaha, Nebr., are in a position to increase their output of tellurium, but not yet in such quantities as to make its use in motor gasoline practicable.

Imports and exports of tellurium are not reported.

THORIUM MINERALS.

Monazite sand produced in the United States and monazite sand and thorium nitrate imported for consumption, 1917–1921.

Year.	Monazite sand produced in the United States.		Imports of monazite sand.		Imports of thorium nitrate.		Price per pound of thorium nitrate.[a]
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
1917	22,000	$1,760	5,828,270	$355,017	1,188	$2,359	[b] $8.00
1918	.....	.....	2,994,515	204,661	.....	.....	[b] 8.00
1919	(c)	(c)	632,568	48,768	3,307	5,250	[b] 3.75
1920	(c)	(c)	1,814,183	141,528	35,640	43,221	(c)
1921	(c)	(c)	50	40	44,554	89,672	(c)

[a] The figures for 1917 to 1919 were kindly furnished by Dr. Hugo Lieber, 23 East Twenty-sixth Street, New York City.
[b] The prices ranged as follows: 1917, $7.00 to $8.00; 1918, $8.00 to $8.25; 1919, $3.75 to $8.
[c] Figures not available for publication.

No exports of thorium minerals are reported.

TIN.

PRODUCTION.

Tin mined in the United States (including Alaska), 1916–1921.

[Metallic tin estimated as obtainable from concentrates produced in tin-mining operations.]

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	140	$122,000	1919	56	$73,400
1917	110	135,600	1920	22	22,000
1918	69	118,500	1921	4	2,400

Smelter output of metallic tin in the United States, 1916–1921, in short tons.

1916	2,261	1919	12,236
1917	6,065	1920	17,652
1918	10,284	1921	11,542

IMPORTS AND EXPORTS.

Tin imported as metal and entered for consumption in the United States, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	69,035	$51,802,232	1919	44,849	$50,890,019
1917	72,166	63,860,340	1920	62,795	73,440,872
1918	71,254	93,144,218	1921	27,101	16,645,719

Tin ore (concentrate) imported into the United States, 1916–1921.

[General imports.]

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	8,040	$4,032,460	1919	19,196	$11,871,948
1917	9,054	4,743,099	1920	34,148	18,795,162
1918	18,394	11,444,401	1921	15,340	5,672,861

Exports of tin ore are insignificant.

Metallic tin (pigs, bars, etc.) of domestic manufacture exported from the United States, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	346	$365,176	1919	306	$415,921
1917	206	232,401	1920	706	770,375
1918	20	31,952	1921	1,154	748,077

PRICES.

Average monthly prices, in cents per pound, of Straits tin in New York, 1920 and 1921.[a]

Month.	1920	1921	Month.	1920	1921
January	62.89	36.11	July	49.37½	27.69
February	60.00	32.47	August	47.69	26.40
March	61.99	28.85	September	44.62	26.73
April	62.20	30.41	October	40.64	27.74
May	55.07	32.52	November	37.02	29.02
June	48.62½	29.57	December	34.15	32.49

[a] Metal Statistics, 1922, p. 327.

Average yearly prices, in cents per pound, of Straits tin in New York, 1916–1921.[a]

1916	43.48	1919	65.54
1917	61.65	1920	50.36
1918	86.80	1921	30.00

[a] Metal Statistics, 1922, p. 327.

TITANIUM MINERALS.

PRODUCTION.

During 1920 rutile (titanium dioxide, TiO_2) and ilmenite (titanium iron oxide, $TiFeO_3$) were produced in this country by the American Rutile Co., at Roseland, Nelson County, Va., but the company did not operate its property during 1921.

Titanium minerals produced in the United States, 1917–1921.

Year.	Rutile concentrates.		Ilmenite concentrates.		Total value.
	Short tons.	Percentage of TiO_2.	Short tons.	Percentage of TiO_2.	
1917	206	93	1,339	53–55	$45,637
1918	261	95	1,644	53–55	57,750
1919 [a]	102	94–96	106	48–50	22,520
1920	277	94–96	268	50	(b)
1921					

[a] Virginia production only; information regarding Florida not available for publication.
[b] Survey not at liberty to publish figures.

IMPORTS AND EXPORTS.

No titanium or "titanium steel-hardening" ores have been imported since 1918. The imports of such steel-hardening ores during the last six months of 1918 were 1,606 pounds, valued at $221. No separate record of similar imports was kept prior to July, 1918. For imports of ferrotitanium see under Ferroalloys.

No separate record of exports of titanium, "titanium steel-hardening" ores, or ferrotitanium is kept.

TRIPOLI.

[See Abrasive materials.]

TUNGSTEN.

SUPPLY.

Supplies of tungsten ores in the United States, 1917–1921, in short tons.

Year.	Production.	Imports.			Exports.[a]		Apparent consumption plus additions to stock on hand (accumulated during the year only).[c]
		Ore.	Tungsten and ferrotungsten.	Estimated equivalent in ore carrying 60 per cent of tungsten trioxide.[b]	Tungsten and ferrotungsten.	Estimated equivalent in ore carrying 60 per cent of tungsten trioxide.	
1917	6,144	4,879	1	5,310	1,162	2,615	8,839
1918	5,061	11,609		12,854	616	1,386	16,529
1919	327	9,408	198	10,915	19	43	11,199
1920	216	1,949	999	4,416	2	5	4,627
1921		1,614	253	2,371			2,371

[a] No record of tungsten ore exported is at hand, although it is known that some has been shipped abroad.
[b] These items include the ore other than Chinese (considered as carrying 65 per cent of tungsten trioxide) and the tungsten and ferrotungsten (considered as equivalent to 2½ times their weight in ore carrying 60 per cent of tungsten trioxide). Chinese ore imported has been considered as 67.5 per cent of tungsten trioxide.
[c] Production plus imports minus estimated equivalent in ore of the exports of tungsten and ferrotungsten. The apparent consumption is at best only an approximation.

PRODUCTION.

No tungsten ores were mined in the United States during 1921. This is the first year in which there has been no production since 1899.

Concentrated tungsten ores (carrying 60 per cent of tungsten trioxide) produced and sold in the United States, 1916–1921, and average value per unit.

Year.	Short tons.	Value.	Average value per unit.	Year.	Short tons.	Value.	Average value per unit.
1916	5,923	$12,074,000	$33.98	1919	327	$353,900	$18.02
1917	6,144	6,783,000	18.40	1920	216	101,800	7.86
1918	5,061	7,049,300	23.24	1921			

Concentrated tungsten ores (carrying 60 per cent tungsten trioxide) produced and sold in the United States, 1917–1920, by States, in short tons.

State.	1917	1918	1919	1920
Alaska	32	14		
Arizona	150	213	50	
California	2,781	1,791	147	
Colorado	2,707	1,910	130	216
Idaho	2			
Nevada	143	898		
New Mexico	(a)	4		
South Dakota	270	201		
Other States [b]	59	30		
	6,144	5,061	327	216

[a] Less than 1 ton.
[b] 1917: Montana, Oregon, Utah, and Washington; 1918: Montana, Utah, and Washington.

IMPORTS AND EXPORTS.

Tungsten-bearing ores imported into the United States, 1920 and 1921, by countries. [a]

[General imports.]

Country.	1920		1921	
	Short tons.	Value.	Short tons.	Value.
Argentina	86	$64,284	57	$11,588
Bolivia	158	85,726	47	13,620
"British Indies"	1	450		
Chile	148	74,906	166	36,389
China	420	142,572	789	106,059
England			189	30,535
France	1	353		
Hongkong	859	276,842	318	72,499
Japan	128	98,723		
Mexico	91	12,055	40	2,639
Panama	13	4,917		
Peru	44	18,765	8	3,428
	1,949	779,593	1,614	276,757

[a] The ore from Panama, Bolivia, Chile, and most of that from Peru is probably from Bolivia; that from China, England, Hongkong, and half of that from Japan is probably from China.

For imports of tungsten and ferrotungsten see also under Ferroalloys.

No tungsten ore of domestic production was exported in 1921. For exports of tungsten and ferrotungsten see also under Ferroalloys.

PRICES.

Tungsten prices can be given only in a general way, for they are always more or less a matter of bargaining, and lots are sold on the same day at considerably different prices. The end of the war and the consequent slump in prices, the subsequent depression in business that became most acute in 1921, and the large imports of the very cheap and rich ore from China caused tungsten prices to drop steadily until they reached the lowest point ever known in this country except for a little surface ore picked up in Boulder County, Colo., before the use of tungsten was established. Some ore carrying more than 65 per cent of tungsten trioxide was sold in New York for $1.60 a unit, and it is possible that a small quantity was sold for even less.

URANIUM AND VANADIUM ORES.

PRODUCTION.

The output of uranium and vanadium ores in 1921 is estimated at 8,540 short tons, containing 109 tons of uranium (128.5 tons of U_3O_8), 201.5 tons of vanadium (359.9 tons of V_2O_5), and about 33 grams of radium. The approximate value, as ore, was probably about $876,000. About 35.693 grams of radium (mostly as sulphate) was isolated during the year. The output of uranium and vanadium ores in 1920 is estimated at 35,076 short tons containing 143.5 tons of uranium (169.1 tons of U_3O_8), 526.7 tons of vanadium (909.8 tons of V_2O_5), and about 43.4 grams of radium. The approximate value, as ore, was probably about $2,401,000. About 32.539 grams of radium in various salts was isolated during the year. Any value given to the output must be arbitrary and open to question, for the larger part of the uranium ores was produced by companies that themselves used the ores. In 1921 no vanadium ores as such were mined in this country, all the vanadium being a by-product of carnotite mined for radium.

More than half of the world's vanadium comes from Peru, and most of the remainder comes from the roscoelite and carnotite fields of southwestern Colorado and southeastern Utah.

Approximate world's production of vanadium, 1917–1921. [a]

Year.	Peru (exports of ore).			United States vanadium content of ore and concentrates produced (short tons).
	Short tons.	Percentage of V_2O_5.	Vanadium contained (short tons).	
1917	4,501	35.78	902	484
1918	2,407	19.10	257	276
1919	3,249	30.41	553	284
1920	11,158	20.43	1,277	527
1921	5,154	[b] 19.64	567	202

[a] Although there is some vanadium produced in other countries, the quantity is small.
[b] Estimate.

IMPORTS AND EXPORTS.

Value of uranium salts and oxide, including some radium salts, imported for consumption in the United States, 1916–1921.

1916	$5,065	1919	$12,960
1917	2,930	1920	3
1918	274	1921	8,552

Vanadium ore (steel-hardening) imported for consumption in the United States, 1918–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1918—July to December [a]	1,772,215	$5,333	1920	20,673,296	$1,080,935
1919	6,026,005	67,846	1921	10,307,540	543,061

[a] Not separately classified prior to July, 1918.

Uranium-radium ore (steel-hardening) imported for consumption in the United States, 1918–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1918—July to December [a]	157	$4,840	1920	396	$1,110
1919			1921	250	446

[a] Not separately classified prior to July, 1918.

For imports of ferrovanadium see under Ferroalloys.

No separate record is kept of vanadium exports. For exports of ferrovanadium see under Ferroalloys.

PRICES.

The price of vanadium in ferrovanadium at the beginning of 1921 was nominally $6.50 to $7 a pound, depending on the silicon and other impurities present. By the middle of February the price was nominally $5 to $6 a pound, and it so remained to the end of the year, but probably at any time lots of several tons could have been bought at a dollar or more less than the quotation.

ZINC.

SUPPLY.

Supplies of primary zinc in the United States, 1917–1921, in short tons.

	1917	1918	1919	1920	1921
Supply:					
Stock, Jan. 1—					
In bonded warehouses	90	32	.....	.....	.....
At smelters	17,508	53,689	41,241	36,793	71,037
Production	669,573	517,927	465,743	463,377	200,500
Imports—					
Foreign	257	35	70	15	6,739
Domestic returned	.....	.....	.....	8,162	731
Total available	687,428	571,683	507,054	508,347	279,007
Withdrawn:					
Exports, foreign, from warehouse	64,680	20,069	12,256	28,132	1,256
Exports, foreign, under drawback	1,588	6,337	4,533	237	130
Exports, domestic	153,796	80,244	129,508	85,898	3,569
Stock, Dec. 31—					
In bonded warehouses	32	.....	.....	.....	131
At smelters	53,689	41,241	36,793	71,037	70,321
Total withdrawn	273,785	147,891	183,090	185,304	75,407
Apparent consumption	413,643	423,792	323,964	323,043	203,600

PRODUCTION.

Primary zinc produced in the United States, 1917–1921, by sources of ore, in short tons.

Source.	1917	1918	1919	1920	1921
United States	584,597	492,405	452,272	450,045	198,232
Foreign:					
Canada	6,787	8,700	4,007	1,583	521
Mexico	40,360	14,043	8,083	8,978	1,614
South America	.....	886	751	536	.....
Europe	11,689	113	.....	.....	.....
Australia	26,140	1,780	630	2,235	133
Total foreign	84,976	25,522	13,471	13,332	2,268
Grand total	669,573	517,927	465,743	463,377	200,500

Primary zinc produced in the United States, 1917–1921, by localities in which smelted, in short tons.

Location of smelter.	1917	1918	1919	1920	1921
Illinois	172,489	141,844	118,458	109,056	48,865
Kansas	76,048	29,149	43,942	41,044	16,573
Oklahoma	204,394	139,066	121,988	110,500	41,244
Other States	216,642	207,868	181,355	202,777	93,818
	669,573	517,927	465,743	463,377	200,500

Primary zinc produced in the United States from domestic ores, 1916–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	564,338	$151,243,000	1919	452,272	$66,032,000
1917	584,597	119,258,000	1920	450,045	72,907,000
1918	492,405	89,618,000	1921	198,232	19,823,000

Secondary zinc recovered as metal in the United States, 1917–1921, in short tons.

	1917	1918	1919	1920	1921
Secondary zinc, redistilled	16,835	9,918	19,748	21,371	17,573
Secondary zinc, remelted	14,565	17,190	20,162	21,479	16,260
Secondary zinc recovered in alloys, excluding old brass remelted	4,800	11,082	6,062	7,650	5,840
Secondary zinc recovered in remelted brass	80,000	82,400	62,400	65,000	38,627

IMPORTS AND EXPORTS.

Zinc imported and entered for consumption in the United States, 1917–1921.

Year.	Blocks or pigs.		Sheets.		Old.		Zinc dust.		Manufactures.	Total value.
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.		
1917	18	$2,279	73	$16,570	259	$25,974	233	$48,604	$250	$93,677
1918	11	2,897	.....	29	24	2,056	16	3,552	331	8,865
1919	32	2,284	1	249	37	2,216	52	5,753	1,258	11,760
1920	.....	17	4	614	14	1,065	17	6,207	1,746	9,649
1921	6,598	559,870	6,688	496,445	6	341	42	1,121	8,290	1,066,067

Zinc ore imported into the United States, 1920 and 1921, by countries.

[General imports.]

Country.	1920			1921		
	Ore (short tons).	Zinc content (short tons).	Value.	Ore (short tons).	Zinc content (short tons).	Value.
Canada	4,731	1,794	$68,286	1,471	554	$14,453
Mexico	47,453	14,975	497,459	6,050	2,147	43,414
Australia	7,805	3,852	197,192	.....	.....	.....
Other countries	5,784	1,866	74,315	18	4	833
	65,773	22,487	837,252	7,539	2,705	58,700

Zinc exported from the United States, 1917–1921.

Year.	Domestic.				Foreign.	
	Slabs.		Sheets.		Slabs.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	137,282	$32,605,767	16,514	$5,730,792	64,680	$12,429,356
1918	66,369	12,469,622	13,875	4,566,756	20,069	3,565,127
1919	109,746	17,524,153	19,762	5,212,002	12,256	1,943,507
1920	74,046	12,495,144	11,852	2,832,993	28,132	4,331,636
1921	1,753	204,984	1,816	425,618	1,256	100,677

Zinc exported from the United States in 1920 and 1921, by destinations.

Destination.	Domestic.				Foreign.	
	Slabs.		Sheets.		Slabs.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1920.						
Canada	196	$31,845	1,697	$416,123	.....	$52
Mexico	82	16,130	635	148,524	153	24,910
France	20,538	3,661,340	902	195,739	4,178	568,970
Great Britain	45,433	7,431,257	1,874	448,878	22,080	3,462,123
Italy	560	114,050	799	186,571	62	9,930
Japan	1,622	276,939	1,112	264,353	698	102,052
Other countries	5,615	963,583	4,833	1,172,805	961	163,599
	74,046	12,495,144	11,852	2,832,993	28,132	4,331,636
1921.						
Canada	106	10,893	808	159,268	136	11,210
Mexico	206	24,106	313	69,380	.....	.....
France	280	32,007	.....	.....	.....	.....
Great Britain	.....	.....	178	50,105	.....	.....
Italy	.....	.....	23	5,308	.....	.....
Japan	819	89,241	96	29,592	1,120	89,467
Other countries	342	48,737	398	111,965	.....	.....
	1,753	204,984	1,816	425,618	1,256	100,677

ZINC RESIDUUM.

[See Manganiferous zinc residuum.]

ZIRCONIUM MINERALS.

PRODUCTION.

No zirconium minerals were produced in the United States from 1912 to 1921, inclusive. The early output of zircon in Norway and in North Carolina was used in the manufacture of incandescent gas mantles. Thoria and ceria have now entirely replaced zirconia in the manufacture of such mantles. The only zirconium mineral produced in the United States is zircon, almost all of which came from North Carolina. Brazil is the world's main producer of zirconium ores. The zirconium minerals produced in Brazil and exported consist of the silicate, zircon, and the oxide, baddeleyite.

Zirconium minerals produced in Brazil and exported, 1916–1921.

Year.	Metric tons.	Equivalent in short tons.	Year.	Metric tons.	Equivalent in short tons.
1916	86	95	1919	208	229
1917	483	532	1920	542	597
1918	2,141	2,360	1921	122	134

IMPORTS.

Zirconium ores (steel-hardening) imported for consumption in the United States, 1918–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1918—July to December[a]	3,216,659	$77,250	1920	.....	.....
1919	11,023	332	1921	131,016	$3,003

[a] Not separately classified prior to July, 1918.

STATE TABLES.

Value of mineral production, 1917 to 1921, by States.[a]

State.	1917	1918	1919	1920	1921
Alabama	$65,024,838	$77,795,572	$65,540,376	$86,289,575	$52,269,451
Alaska	40,710,655	28,217,407	19,616,909	23,396,144	17,041,057
Arizona	212,615,978	203,992,915	112,512,239	146,383,335	30,818,365
Arkansas	12,061,702	14,081,691	10,709,213	17,813,328	22,515,112
California	175,399,036	204,675,547	213,823,488	269,404,686	297,025,679
Colorado	80,296,218	79,003,928	59,353,279	76,037,896	54,045,056
Connecticut	3,981,203	3,501,460	5,152,124	6,326,326	4,219,457
Delaware	523,991	372,804	390,706	359,833	379,785
District of Columbia	204,936	99,221	105,623	369,534	411,745
Florida	7,294,467	7,758,732	10,513,495	22,923,780	12,597,948
Georgia	7,650,553	8,312,051	9,429,972	12,178,695	8,650,003
Idaho	55,224,026	36,872,270	19,044,567	32,449,783	16,502,273
Illinois	234,735,962	271,244,365	213,701,212	373,926,540	254,019,136
Indiana	83,798,648	96,558,784	82,270,784	146,736,294	97,700,676
Iowa	39,336,372	38,742,009	37,882,183	57,250,480	35,639,505
Kansas	106,763,055	147,902,091	120,759,783	198,097,758	113,098,346
Kentucky	77,174,802	104,165,945	110,305,840	195,920,036	114,404,662
Louisiana	37,521,872	54,769,225	38,851,509	138,745,725	61,061,974
Maine	3,726,121	3,727,107	4,073,870	5,428,086	4,392,039
Maryland	19,617,596	20,866,706	18,345,024	30,944,378	16,083,965
Massachusetts	7,225,750	7,258,088	10,070,543	12,411,708	9,835,107
Michigan	163,997,853	158,312,121	122,973,774	166,338,818	69,551,198
Minnesota	152,490,554	155,412,823	131,529,797	177,589,967	72,609,973
Mississippi	966,135	925,192	1,628,031	2,201,246	1,954,353
Missouri	105,342,678	76,663,995	61,862,232	90,994,479	56,375,543
Montana	123,650,330	139,331,507	73,630,824	85,885,403	30,161,734
Nebraska	7,943,729	6,513,422	7,658,424	7,168,424	2,366,287
Nevada	55,408,057	51,080,169	24,457,735	25,648,961	14,038,071
New Hampshire	1,594,584	1,453,921	2,294,959	2,986,485	2,234,007
New Jersey	57,710,181	49,510,290	56,898,033	72,335,207	47,429,290
New Mexico	43,312,947	40,631,024	22,679,960	27,883,565	13,227,268
New York	52,123,552	52,768,877	56,779,564	78,431,317	62,567,967
North Carolina	5,246,391	4,973,386	6,223,953	7,760,482	5,456,479
North Dakota	1,749,549	1,823,109	2,413,025	3,078,548	2,500,349
Ohio	217,671,746	246,162,215	214,829,888	355,844,499	223,533,658
Oklahoma	259,134,377	336,857,921	291,078,174	493,320,359	269,882,786
Oregon	4,074,247	4,191,740	3,962,822	5,496,253	5,199,803
Pennsylvania	869,800,965	979,245,098	918,048,917	1,314,332,585	944,688,650
Rhode Island	717,123	760,787	853,981	1,175,653	922,765
South Carolina	1,393,297	1,558,543	2,370,916	2,825,479	1,754,491
South Dakota	8,348,684	7,441,981	5,842,704	5,950,878	7,498,656
Tennessee	36,910,448	39,229,614	37,134,899	55,023,232	33,754,823
Texas	75,958,481	110,306,367	190,563,015	371,250,979	212,141,250
Utah	113,433,596	105,785,474	64,165,525	76,536,657	40,595,872
Vermont	8,980,573	9,158,945	11,728,052	15,008,894	10,650,213
Virginia	32,243,648	37,639,368	36,799,407	60,161,247	32,810,842
Washington	18,576,052	20,999,691	18,267,938	26,677,191	17,605,878
West Virginia	306,916,191	327,962,620	298,168,194	547,872,937	316,180,647
Wisconsin	24,976,780	20,091,146	18,772,601	19,630,114	9,990,961
Wyoming	29,547,428	42,595,812	41,097,209	83,034,397	51,365,150

[a] In this table iron ore, not pig iron, is taken as the basis of valuation of iron, and in the case of other metals mine production (recoverable content of metals) is the basis.

Mineral production of Alabama in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Barytes.....short tons..	(a)	(a)	(a)	(a)
Bauxite.....long tons..	(a)	(a)	(a)	(a)
Cement.....barrels..	b1,117,622	b$2,557,973	b1,714,286	b$3,466,223
Clay products.....	.....	3,422,146	.....	c2,266,704
Clay, raw.....short tons..	47,512	d91,010	46,852	d48,736
Coal.....do....	16,294,099	59,410,000	12,568,899	38,713,000
Coke.....do....	4,013,891	d35,260,036	2,534,039	d12,256,085
Ferroalloys.....long tons..	(a d)	(a d)	(a d)	(a d)
Fuller's earth.....short tons..	(a)	(a)	(a)	(a)
Gold.....troy ounces..	14	296	.....	.....
Graphite, crystalline.....pounds..	4,894,648	306,977	(a)	(a)
Iron ore.....long tons..	5,833,317	15,993,985	2,835,761	5,058,161
Iron, pig.....do.....	2,339,939	d76,520,797	1,241,227	d30,195,978
Lime.....short tons..	151,595	1,175,518	109,256	847,629
Manganese ore.....long tons..	57	1,923	.....	.....
Manganiferous ore.....do....	150	(a)	.....	.....
Mica:				
Scrap.....short tons..	222	5,234	.....	.....
Sheet.....pounds..	81,458	16,401	.....	.....
Millstones.....	.....	(a)	.....	(a)
Mineral waters.....gallons sold..	1,461	916	892	690
Sand and gravel.....short tons..	886,337	485,639	774,616	381,425
Silver.....troy ounces..	9	10	.....	.....
Stone.....short tons..	1,355,170	2,544,334	576,610	1,304,965
Miscellaneous.....	.....	2,500,796	.....	1,787,022
Total value, eliminating duplications.....	.....	86,289,575	.....	52,269,451

a Value included under "Miscellaneous."
b Exclusive of puzzolan, value for which is included under "Miscellaneous."
c Figures obtained through cooperation with Bureau of the Census.
d Value not included in total value for State.

Mineral production of Alaska in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Coal.....short tons..	61,111	$356,000	76,817	$496,000
Copper.....pounds..	70,435,363	12,960,106	57,011,597	7,354,496
Gold.....troy ounces..	404,684	8,365,560	390,558	8,073,540
Gypsum.....short tons..	(a)	(a)	(a)	(a)
Lead.....do....	875	140,000	759	68,279
Petroleum.....barrels..	(b)	(b)	(b)	(b)
Platinum and allied metals.....troy ounces..	1,113	120,366	551	34,518
Silver.....do.....	953,546	1,039,365	761,085	761,085
Stone.....short tons..	(b)	(b)	(b)	(b)
Tin (metallic equivalent).....do....	16	16,112	4	2,400
Miscellaneous.....	.....	398,605	.....	250,739
Total value, eliminating duplications.....	.....	23,396,114	.....	17,041,057

a Calcined in Washington State. Value included under "Miscellaneous."
b Value included under "Miscellaneous."

Mineral production of Arizona in 1920 and 1921.

Product.		1920		1921	
		Quantity.	Value.	Quantity.	Value.
Asbestos	short tons	1,200	$653,742	413	$311,768
Clay products			163,329		[a] 154,543
Copper	pounds	558,256,302	102,719,160	185,034,194	23,869,411
Fluorspar	short tons	181	3,264		
Gems and precious stones			5,328		8,805
Gold	troy ounces	231,529	4,786,122	141,753	2,930,303
Gypsum	short tons	[b]	[b]	6,985	55,980
Iron ore	long tons	950	[b]		
Lead	short tons	7,300	1,167,981	3,271	294,364
Lime	do	12,990	184,850	11,783	162,647
Manganese ore	long tons	2,402	72,067	328	[b]
Manganiferous ore	do	345	[b]		
Sand and gravel	short tons	13,275	8,428	383,167	287,477
Silica (quartz)	do	[b]	[b]		
Silver	troy ounces	5,355,303	5,837,280	2,469,394	2,469,394
Stone	short tons	431,390	329,264	[c] 256,510	[c] 132,797
Sulphuric acid [d]	do	[b]	[b]	[a b]	[a b]
Vanadium ore	do	500	10,000		
Zinc	do	729	118,041		
Miscellaneous			324,479		140,874
Total value, eliminating duplications			116,383,335		30,818,363

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Value included under "Miscellaneous."
[c] Exclusive of limestone, value for which is included under "Miscellaneous."
[d] From copper smelting.

Mineral production of Arkansas in 1920 and 1921.

Product.		1920		1921	
		Quantity.	Value.	Quantity.	Value.
Bauxite	long tons	481,279	$2,897,892	124,850	$755,400
Clay products			[a] 1,353,761		[a b] 731,668
Clay, raw	short tons	[c d]	[c d]	193	[d] 2,189
Coal	do	2,103,596	9,592,000	1,227,777	5,360,000
Fuller's earth	do	[c]	[c]	[c]	[c]
Gems and precious stones			[c]		[e]
Iron ore sold for magnets	long tons	[c]	[c]		
Lead	short tons	8	1,280	21	1,890
Lime	do	11,479	135,399	8,958	93,499
Manganese ore	long tons	3,445	93,077	728	16,360
Manganiferous ore	do	4,550	39,227	278	3,683
Marl, calcareous	short tons	[c]	[c]	6,000	12,000
Mineral waters	gallons sold	900,597	41,359	313,322	31,984
Natural gas	M cubic feet	9,027,000	1,906,900	4,260,000	984,000
Oilstones	short tons	209	120,671	122	80,626
Petroleum	barrels	[c]	[c]	10,473,000	12,746,000
Sand and gravel	short tons	909,007	554,003	1,464,007	782,812
Stone	do	[f] 643,000	[f] 908,969	[f] 715,610	[f] 821,169
Zinc	do	329	53,298	15	1,500
Miscellaneous			118,492		92,821
Total value, eliminating duplications			17,813,328		22,515,412

[a] Exclusive of pottery, value for which is included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value included under "Miscellaneous."
[d] Value not included in total value for State.
[e] No data available.
[f] Exclusive of marble, value for which is included under "Miscellaneous."

Mineral production of California in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Asbestos.....short tons..	(a)	(a)	25	$1,500
Asphalt.....do....	246,695	$4,500,002	226,987	3,732,812
Barytes.....do....	2,250	20,850	942	5,084
Borates.....do....	120,320	2,173,000	49,800	1,593,000
Briquets, fuel.....do....	(a b)	(a b)	(a b)	(a b)
Calcium chloride.....do....	(a)	(a)	1,000	12,000
Cement.....barrels..	7,064,010	15,449,645	7,180,700	16,856,258
Chromite.....long tons..	1,416	33,687	123	1,286
Clay products.....		10,946,423		c 11,172,491
Clay, raw.....short tons..	214,799	b 437,078	181,039	b 341,288
Coal.....do....	(a)	(a)	(a)	(a)
Copper.....pounds..	12,626,272	2,323,234	11,743,404	1,514,899
Diatomaceous earth.....short tons..	(a)	(a)	d 50,000	d 625,000
Feldspar (crude).....long tons..	1,021	4,797	(a)	(a)
Fuller's earth.....short tons..	(a)	(a)		
Gems and precious stones.....		5,504		(a)
Gold.....troy ounces..	692,297	14,311,043	759,721	15,704,822
Graphite, crystalline.....pounds..	(a)	(a)	(a)	(a)
Gypsum.....short tons..	(a)	(a)	40,526	151,570
Iron ore:				
Sold to furnaces.....long tons..	6,592	44,844	2,064	15,364
Sold for paint.....do....	(a)	(a)		
Lead.....short tons..	2,407	385,081	562	50,592
Lime.....do....	48,571	653,075	42,115	577,366
Lithium minerals.....do....	(a)	(a)	(a)	(a)
Magnesite.....do....	81,782	1,083,262	47,904	510,177
Manganese ore.....long tons..	1,733	53,285		
Marl, calcareous.....short tons..	(a)	(a)	(a)	(a)
Mineral paints, zinc and lead pigments...do....			(a b)	(a b)
Mineral waters.....gallons sold..	2,674,086	326,295	3,260,609	367,313
Natural gas.....M cubic feet..	66,041,000	12,528,000	75,942,000	16,496,000
Natural-gas gasoline.....gallons..	48,207,976	8,323,819	58,220,498	9,874,594
Peat.....short tons..	9,927	77,614	12,672	117,580
Pebbles for grinding.....do....	(a)	(a)	(a)	(a)
Petroleum.....barrels..	103,377,000	178,395,000	112,600,000	203,138,000
Platinum and allied metals.....troy ounces..	448	72,034	682	63,837
Potash (K_2O).....short tons..	10,379	1,823,667	2,106	193,951
Pumice.....do....	650	12,710	(a)	(a)
Pyrites.....long tons..	128,114	519,078	98,252	467,958
Quicksilver.....flasks..	9,849	784,571	3,055	144,868
Salt.....short tons..	212,008	1,301,426	193,618	1,043,912
Sand and gravel.....do....	4,679,949	2,707,657	4,704,214	3,249,079
Sand and sandstone (finely ground).....do....	(a)	(a)		
Sand-lime brick.....thousands..	(a)	(a)		
Silica (quartz).....short tons..	(a)	(a)	(a)	(a)
Silver.....troy ounces..	1,706,327	1,859,896	3,629,223	3,629,223
Sodium salts (carbonate, bicarbonate, sulphate, and trona) from natural sources...short tons..	34,067	1,155,449	17,000	601,250
Stone.....do....	4,424,640	5,618,777	4,071,770	4,795,771
Sulphuric acid e.....do....	(a)	(a)		
Talc.....do....	13,199	232,182	8,233	128,188
Zinc.....do....	583	94,406	529	52,887
Miscellaneous.....		1,790,475		493,877
Total value, eliminating duplications.....		269,404,686		297,025,679

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures obtained through cooperation with Bureau of the Census.
d Estimated.
e From copper smelting.

Mineral production of Colorado in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	$3,671,241	.....	b $2,711,668
Clay, raw.....short tons..	131,797	c 172,378	94,765	c 119,091
Coal.....do....	12,278,225	42,829,000	d 9,122,760	d 32,377,000
Coke.....do....	789,499	e 6,661,534	368,131	e 3,086,728
Copper.....pounds..	4,043,734	744,047	4,153,442	535,794
Feldspar (crude).....long tons..	.....	.....	(a)	(a)
Ferroalloys.....do....	(a c)	(a c)	(a c)	(a c)
Fluorspar.....short tons..	12,852	251,308	3,143	39,907
Gems and precious stones.....	.....	1,090	.....	3,848
Gold.....troy ounces..	366,504	7,576,319	330,659	6,835,328
Graphite, amorphous.....short tons..	(a)	(a)	(a)	(a)
Gypsum.....do....	(a)	(a)	(a)	(a)
Iron ore.....long tons..	1,914	(a)	3,823	(a)
Iron, pig.....do....	(a c)	(a c)	(a c)	(a c)
Lead.....short tons..	23,315	3,730,383	9,830	884,721
Lime.....do....	1,914	23,628	5,783	56,956
Manganese ore.....long tons..	3,643	52,545	490	(a)
Manganiferous ore.....do....	45,726	152,814	11,743	36,936
Mica, scrap.....short tons..	(a)	(a)	(a)	(a)
Mineral paints, zinc and lead pigments.....do....	(a c)	(a c)	(a c)	(a c)
Mineral waters.....gallons sold..	227,208	67,538	234,560	70,925
Natural gas.....M cubic feet..	8,500	1,100	4,000	1,000
Oil shale.....short tons..	.....	.....	2	40
Petroleum.....barrels..	111,000	199,000	108,200	132,000
Potash (K_2O).....short tons..	1,046	230,350	(a)	(a)
Pyrites.....long tons..	25,523	123,674	7,290	18,475
Sand and gravel.....short tons..	222,716	158,797	277,283	194,722
Shale oil.....gallons..	.....	.....	e 5,000	1,000
Silica (quartz).....short tons..	(a)	(a)	.....	.....
Silver.....troy ounces..	5,409,335	5,896,175	5,631,657	5,631,657
Stone.....short tons..	553,040	810,590	333,840	559,605
Sulphur.....long tons..	.....	.....	(a)	(a)
Tungsten ore (60 per cent concentrates).....short tons..	216	101,800	.....	.....
Uranium and vanadium ores.....do....	33,049	2,284,029	8,487	870,560
Zinc.....do....	24,395	3,952,050	1,180	118,000
Miscellaneous.....	.....	15,426,067	.....	7,994,636
Total value, eliminating duplications.....	.....	76,037,896	.....	54,045,056

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.
d Exclusive of 14,869 tons produced at small mines, value for which is included under "Miscellaneous."
e Also 1,250 gallons used in manufacture of soap, stock dip, ointment, etc.

Mineral production of Connecticut in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	$3,255,295	.....	a $1,703,528
Clay, raw.....short tons..	(b c)	(b c)	139	c 480
Diatomaceous earth.....do....	(b)	(b)	(b)	(b)
Feldspar (crude).....long tons..	7,719	64,066	9,565	65,864
Gems and precious stones.....	.....	971	.....	(b)
Iron ore.....long tons..	3,700	(b)	.....	.....
Iron, pig.....do....	1,698	(b c)	(b c)	(b c)
Lime.....short tons..	(b)	(b)	(b)	(b)
Mineral waters.....gallons sold..	1,275,451	72,797	866,253	50,679
Sand and gravel.....short tons..	341,371	279,557	335,402	180,360
Silica (quartz).....do....	(b)	(b)	(b)	(b)
Stone.....do....	1,284,440	1,796,724	1,252,860	1,529,746
Miscellaneous.....	.....	979,115	.....	712,149
Total value, eliminating duplications.....	.....	6,326,326	.....	4,219,457

a Figures obtained through cooperation with Bureau of the Census.
b Value included under "Miscellaneous."
c Value not included in total value for State.

Mineral production of Delaware in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products		$279,005		[a] $208,154
Clay, raw, short tons	10,007	[b] 97,492	2,137	[b] 17,314
Sand and gravel, do	31,320	20,337	43,958	25,347
Stone, do	(c)	(c)	(c)	(c)
Miscellaneous		60,491		146,284
Total value, eliminating duplications		359,833		379,785

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Value not included in total value for State.
[c] Value included under "Miscellaneous."

Mineral production of the District of Columbia in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products		[a] $60,880		[a b] $138,188
Ferroalloys, long tons	(c d)	(c d)	(c d)	(c d)
Sand and gravel, short tons	(c)	(c)	(c)	(c)
Sand-lime brick, thousands	(c)	(c)	(b c)	(b c)
Stone, short tons	5,050	11,900	12,360	12,087
Miscellaneous		345,590		272,655
Total value, eliminating duplications		369,534		411,745

[a] Exclusive of pottery, value for which is included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value included under "Miscellaneous."
[d] Value not included in total value for State.

Mineral production of Florida in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products		[a] $312,150		[b] $178,809
Clay, raw, short tons	(c d)	(c d)	28,426	[d] 388,751
Fuller's earth, do	(c)	(c)	57,268	1,109,823
Lime, do	(c)	(c)	(c)	(c)
Mineral waters, gallons sold	268,470	27,120	321,472	28,365
Monazite sand, pounds	(e)	(e)	(e)	(e)
Peat, short tons	(c)	(c)	(c)	(c)
Phosphate rock, long tons	3,369,384	19,464,362	1,780,028	10,431,642
Sand and gravel, short tons	132,749	117,601	160,445	97,324
Sand lime brick, thousands	(c)	(c)	(b c)	(b c)
Stone, short tons	340,470	430,130	[f] 564,240	[f] 471,895
Miscellaneous		3,084,441		280,090
Total value, eliminating duplications		22,923,780		12,597,948

[a] Exclusive of pottery, value for which is included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value included under "Miscellaneous."
[d] Value not included in total value for State.
[e] No data available for publication.
[f] Exclusive of flinty limestone, value for which is included under "Miscellaneous."

Mineral production of Georgia in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Asbestos.....short tons..	(a)	(a)	(a)	(a)
Barytes.....do....	84,644	$790,362	24,614	$191,442
Bauxite.....long tons..	34,397	300,187	10,200	92,600
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	5,572,999	.....	b 3,357,374
Clay, raw.....short tons..	187,364	c 1,071,794	55,160	c 400,215
Coal.....do....	50,156	251,000	33,815	171,000
Coke.....do....	16,523	c 197,285	6,943	c 80,828
Copper.....pounds..	5,780	1,064	.....	.....
Fuller's earth.....short tons..	(a)	(a)	(a)	(a)
Gems and precious stones.....	.....	(a)	.....	.....
Gold.....troy ounces..	35	732	49	1,022
Iron ore:				
Sold to furnaces.....long tons..	104,482	460,633	3,822	13,678
Sold for paint.....do....	(a)	(a)	(a)	(a)
Lead.....short tons..	2	304	.....	.....
Lime.....do....	(a)	(a)	(a)	(a)
Manganese ore.....long tons..	341	9,512	.....	.....
Manganiferous ore.....do....	6,075	(a)	13,302	(a)
Mica:				
Scrap.....short tons..	101	3,015	75	1,700
Sheet.....pounds..	50,095	13,692	12,730	2,640
Mineral waters.....gallons sold..	343,888	31,868	306,637	22,757
Peat.....short tons..	(a)	(a)	(a)	(a)
Pyrites.....long tons..	(a)	(a)	(a)	(a)
Sand and gravel.....short tons..	375,052	231,858	329,048	177,745
Sand-lime brick.....thousands..	3,523	55,528	(a b)	(a b)
Silver.....troy ounces..	194	211	4	4
Slate.....	.....	.....	.....	(a)
Stone.....short tons..	508,370	3,651,415	362,630	2,924,035
Talc.....do....	(a)	(a)	(a)	(a)
Miscellaneous.....	.....	804,315	.....	1,694,006
Total value, eliminating duplications....	.....	12,178,695	.....	8,650,003

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.

Mineral production of Idaho in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Asbestos.....short tons..	.....	.....	(a)	(a)
Clay products.....	.....	$306,652	.....	b $78,653
Clay, raw.....short tons..	873	c 8,802	196	c 2,369
Coal.....do....	(a)	(a)	(a)	(a)
Copper.....pounds..	2,538,396	467,065	1,688,195	217,777
Diatomaceous earth.....short tons..	(a)	(a)	.....	.....
Gems and precious stones.....	.....	(a)	.....	.....
Gold.....troy ounces..	23,490	485,590	26,400	545,731
Iron ore.....long tons..	275	(a)	799	(a)
Lead.....short tons..	124,805	19,968,798	99,235	8,931,110
Lime.....do....	(a)	(a)	(a)	(a)
Mica:				
Scrap.....do....	(a)	(a)	.....	.....
Sheet.....pounds..	(a)	(a)	.....	.....
Phosphate rock.....long tons..	53,734	292,006	(a)	(a)
Quicksilver.....flasks..	.....	.....	(a)	(a)
Salt.....short tons..	(a)	(a)	.....	.....
Sand and gravel.....do....	24,939	19,956	266,853	107,000
Silver.....troy ounces..	7,326,794	7,986,205	6,080,528	6,080,528
Stone.....short tons..	254,490	616,066	d 273,490	d 478,730
Zinc.....do....	13,966	2,262,518	17	1,673
Miscellaneous.....	.....	44,927	.....	61,071
Total value, eliminating duplications.....	.....	32,449,783	.....	16,502,273

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.
d Exclusive of sandstone, value for which is included under "Miscellaneous."

Mineral production of Illinois in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	85,575	$1,521,318	129,183	$1,372,891
Barytes.....do....	(a)	(a)	(a)	(a)
Cement.....barrels..	b 5,148,040	b 10,012,158	b5,237,510	b 9,092,982
Clay products.....	.....	26,138,419	.....	c 19,041,182
Clay, raw.....short tons..	195,421	d 432,964	89,060	d 177,004
Coal.....do....	88,724,893	273,509,000	69,602,763	190,986,000
Coke.....do....	2,136,793	d 25,791,092	1,322,178	d 11,383,808
Ferroalloys.....long tons..	(a d)	(a d)	(a d)	(a d)
Fluorspar.....short tons..	120,299	3,096,767	12,477	315,767
Iron, pig.....long tons..	3,238,814	d 90,736,015	1,490,638	d 36,513,263
Lead.....short tons..	1,743	278,880	672	60,480
Lime.....do....	87,903	982,743	58,222	610,197
Mineral paints, zinc and lead pigments....do....	(a d)	(a d)	(a d)	(a d)
Mineral waters.....gallons sold..	301,953	17,211	351,277	21,871
Natural gas.....M cubic feet..	3,013,000	477,000	2,646,000	356,000
Natural-gas gasoline.....gallons..	6,054,916	1,307,980	7,536,073	1,101,227
Peat.....short tons..	(a)	(a)	(a)	(a)
Petroleum.....barrels..	10,774,000	39,583,000	10,043,000	20,632,000
Pyrites.....long tons..	(a)	(a)	.....	.....
Sand and gravel.....short tons..	7,669,500	6,139,169	6,459,692	4,016,806
Sand and sandstone (finely ground).....do....	63,664	425,824	33,291	230,001
Silver.....troy ounces..	8,193	8,930	1,345	1,345
Stone.....short tons..	5,103,700	5,673,831	4,330,620	4,352,960
Sulphur acid (60° Baumé) e.....do....	f 285,693	3,051,202	c 134,503	c 1,351,654
Tripoli.....do....	24,458	360,651	7,765	125,352
Zinc.....do....	4,720	764,640	2,426	242,600
Miscellaneous.....	.....	3,288,128	.....	1,963,376
Total value, eliminating duplications.....	.....	373,926,540	.....	254,019,136

a Value included under "Miscellaneous."
b Exclusive of natural cement, value for which is included under "Miscellaneous."
c Figures obtained through cooperation with Bureau of the Census.
d Value not included in total value for State.
e From zinc smelting.
f Includes several thousand tons of stronger acid not converted to 60° Baumé.

Mineral production of Indiana in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	$15,494,795	.....	b $11,199,024
Clay, raw.....short tons..	76,341	c 124,200	43,092	c 68,937
Coal.....do....	29,350,585	92,867,000	20,319,509	52,269,000
Coke.....do....	4,553,697	c 46,994,153	3,091,263	c 19,007,519
Iron, pig.....long tons..	2,418,048	c 61,852,856	1,655,275	c 36,945,411
Lime.....short tons..	134,672	1,348,819	90,542	826,311
Mineral waters.....gallons sold..	571,293	183,939	541,190	158,790
Natural gas.....M cubic feet..	1,779,000	758,000	1,066,000	547,000
Oilstones.....short tons..	469	50,200	199	28,426
Peat.....do....	(a)	(a)	.....	.....
Petroleum.....barrels..	945,000	3,407,000	1,158,000	2,414,000
Sand and gravel.....short tons..	5,271,026	2,846,861	5,277,504	2,781,299
Sand-lime brick.....thousands..	10,034	128,013	(a b)	(a b)
Stone.....short tons..	2,382,200	9,228,755	2,489,890	8,985,036
Sulphuric acid d.....do....	(a)	(a)	.....	.....
Miscellaneous.....	.....	20,422,912	.....	18,491,790
Total value, eliminating duplications.....	.....	146,736,294	.....	97,700,676

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.
d From zinc smelting.

Mineral production of Iowa in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Cement.....barrels..	4,421,783	$8,742,854	4,151,439	$7,439,983
Clay products.....	.....	[a] 10,439,957	.....	[a b] 5,711,583
Clay, raw.....short tons..	36,577	[c] 36,275	7,457	[c] 7,617
Coal.....do....	7,813,916	30,794,000	4,531,392	17,256,800
Ferroalloys.....long tons..	[c d]	[c d]	[c d]	[c d]
Gypsum.....short tons..	571,895	4,422,965	350,247	2,922,700
Lime.....do....	[d]	[d]	[d]	[d]
Mineral waters.....gallons sold..	38,877	3,419	21,100	2,105
Natural gas.....M cubic feet..	800	300	700	300
Sand and gravel.....short tons..	2,467,644	1,993,441	2,641,982	1,726,958
Stone.....do....	612,150	749,692	417,890	516,730
Miscellaneous.....	.....	638,997	.....	265,923
Total value, eliminating duplications.....	.....	57,250,480	.....	35,639,505

[a] Exclusive of pottery, value for which is included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value not included in total value for State.
[d] Value included under "Miscellaneous."

Mineral production of Kansas in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	[a]	[a]	[a]	[a]
Cement.....barrels..	[b] 4,158,399	[b] $8,649,157	[b] 3,643,582	[b] $7,253,944
Clay products.....	.....	[c] 4,921,740	.....	[d] 3,739,594
Coal.....short tons..	5,926,408	22,923,000	3,466,641	13,333,300
Gypsum.....do....	130,044	968,298	92,526	665,164
Lead.....do....	16,788	2,686,080	18,679	1,681,110
Lime.....do....	[a]	[a]	.....	.....
Mineral paints, zinc and lead pigments....do....	[a e]	[a e]	[a e]	[a e]
Mineral waters.....gallons sold..	422,069	57,361	421,294	55,982
Natural gas.....M cubic feet..	21,158,000	7,164,000	15,717,000	7,382,000
Natural-gas gasoline.....gallons..	4,330,748	828,887	3,587,329	565,408
Petroleum.....barrels..	39,005,000	133,469,000	36,456,000	68,694,000
Pumice.....short tons..	[a]	[a]	34,172	125,642
Salt.....do....	783,655	3,839,409	665,968	3,268,661
Sand and gravel.....do....	1,275,309	905,936	1,082,914	647,723
Stone.....do....	699,190	1,013,891	378,680	675,145
Sulphuric acid [f].....do....	.....	.....	[a d]	[a d]
Zinc.....do....	61,073	9,893,826	36,994	3,699,400
Miscellaneous.....	.....	1,948,798	.....	1,913,259
Total value, eliminating duplications.....	.....	198,097,758	.....	113,098,346

[a] Value included under "Miscellaneous."
[b] Exclusive of natural cement, value for which is included under "Miscellaneous."
[c] Exclusive of pottery, value for which is included under "Miscellaneous."
[d] Figures obtained through cooperation with Bureau of the Census.
[e] Value not included in total value for State.
[f] From zinc smelting.

Mineral production of Kentucky in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	(a)	(a)	(a)	(a)
Barytes.....do....	(a)	(a)		
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....		$7,309,194		b $4,322,781
Clay, raw.....short tons..	93,491	c 469,302	35,587	c 204,400
Coal.....do....	35,690,762	146,576,000	31,588,270	85,092,600
Coke.....do....	739,577	c 5,576,205	284,825	c 1,863,707
Fluorspar.....do....	46,091	1,246,942	15,266	294,513
Iron, pig.....long tons..	230,316	c 7,306,711	28,375	c 816,372
Lead.....short tons..	122	19,520	69	6,210
Lime.....do....	1,757	18,063	1,524	11,551
Mineral waters.....gallons sold..	256,959	39,600	255,475	37,174
Natural gas.....M cubic feet..	3,345,000	1,064,000	4,820,000	1,597,000
Natural-gas gasoline.....gallons..	4,497,320	1,071,628	4,241,938	834,983
Oilstones.....short tons..	(a)	(a)	(a)	(a)
Petroleum.....barrels..	8,738,000	34,279,000	9,012,600	16,736,060
Phosphate rock.....long tons...	(a)	(a)	(a)	(a)
Sand and gravel.....short tons..	1,637,618	1,047,770	1,356,512	963,584
Stone.....do....	1,422,530	1,756,176	1,573,750	1,877,487
Zinc.....do....	9	1,458	220	22,000
Miscellaneous.....		1,490,685		2,608,779
Total value, eliminating duplications.....		195,920,036		114,404,662

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.

Mineral production of Louisiana in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products.....		a $955,608		a b $587,868
Mineral waters.....gallons sold..	(c)	(c)	(c)	(c)
Natural gas.....M cubic feet..	58,274,000	5,768,000	58,004,000	5,460,000
Natural-gas gasoline.....gallons..	10,609,629	1,712,613	15,340,374	1,812,268
Petroleum.....barrels..	35,714,000	112,606,000	27,103,000	42,469,000
Salt.....short tons..	265,085	1,517,414	(c)	(c)
Sand and gravel.....do....	1,072,468	791,147	1,821,695	1,491,406
Sand-lime brick.....thousands..	(c)	(c)	(b c)	(b c)
Stone.....short tons..	(c)	(c)	(c)	(c)
Sulphur.....long tons..	(c)	(c)	(c)	(c)
Miscellaneous.....		15,394,943		9,241,432
Total value, eliminating duplications.....		138,745,725		61,061,974

a Exclusive of pottery, value for which is included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value included under "Miscellaneous."

Mineral production of Maine in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products.....		$838,258		a $631,480
Feldspar (crude).....long tons..	45,352	329,626	18,866	134,168
Ferroalloys.....do....	(b c)	(b c)	(b c)	(b c)
Gems and precious stones.....		3,738		(b)
Lime.....short tons..	101,503	1,495,625	90,585	1,392,850
Mineral waters.....gallons sold..	732,810	301,851	744,775	309,757
Sand and gravel.....short tons..	76,493	82,237	40,884	36,359
Silica (quartz).....do....	(b)	(b)		
Slate.....		450,561		409,303
Stone.....short tons..	192,440	1,924,990	201,490	1,477,522
Miscellaneous.....		178,500		7,968
Total value, eliminating duplications.....		5,428,086		4,392,039

a Figures obtained through cooperation with Bureau of the Census.
b Value included under "Miscellaneous."
c Value not included in total value for State.

Mineral production of Maryland in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Asbestos.....short tons..	(a)	(a)	3	$12,000
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	$3,973,178	.....	b 2,541,888
Clay, raw.....short tons..	27,772	c 116,280	26,108	c 54,471
Coal.....do....	4,065,239	18,815,000	1,827,740	6,602,000
Coke.....do....	682,132	c 3,785,833	292,439	(a c)
Diatomaceous earth.....do....	(a)	(a)	(a)	(a)
Feldspar (crude).....long tons..	17,999	100,822	5,155	33,798
Ferroalloys.....do....	(a c)	(a c)	(a c)	(a c)
Iron ore:				
Sold to furnaces.....do....	1,360	(a)	1,580	(a)
Sold for paint.....do....	(a)	(a)	.....	.....
Iron, pig.....do....	(a c)	(a c)	(a c)	(a c)
Lime.....short tons..	100,914	951,588	64,835	558,785
Marl, calcareous.....do....	.....	.....	170	680
Millstones.....	.....	(a)	.....	.....
Mineral paints, zinc and lead pigments .....short tons..	(a c)	(a c)	.....	.....
Mineral waters.....gallons sold..	986,379	95,565	888,948	87,138
Natural gas.....M cubic feet..	200	100	200	100
Potash (K_2O).....short tons..	1,447	313,505	(a)	(a)
Sand and gravel.....do....	1,543,791	1,627,889	1,543,453	1,592,735
Silica (quartz).....do....	2,261	30,588	(a)	(a)
Slate.....	.....	80,789	.....	(a)
Stone.....short tons..	d 811,500	d 1,273,741	896,520	1,457,937
Talc.....do....	4,372	17,948	(a)	(a)
Miscellaneous.....	.....	26,407,483	.....	6,783,797
Total value, eliminating duplications.....	.....	30,944,378	.....	16,083,965

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.
d Exclusive of marble, value for which is included under "Miscellaneous."

Mineral production of Massachusetts in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	$3,498,378	.....	a $2,030,389
Clay, raw.....short tons..	(b c)	(b c)	26	c 90
Coke.....do....	488,089	(b c)	294,059	(b c)
Fuller's earth.....do....	(b)	(b)	(b)	(b)
Gems and precious stones.....	.....	.....	.....	(b)
Gold.....troy ounces.	9	178	.....	.....
Iron ore.....long tons..	8,537	(b)	1,262	(b)
Iron, pig.....do....	3,906	(b c)	(b c)	(b c)
Lead.....short tons..	14	2,206	.....	.....
Lime.....do....	129,108	1,753,110	124,183	1,890,512
Mineral waters.....gallons sold..	1,277,708	105,008	1,088,921	72,792
Peat.....short tons..	(b)	(b)	(b)	(b)
Sand and gravel.....do....	1,246,956	1,400,335	1,121,954	1,201,441
Sand-lime brick.....thousands..	(b)	(b)	(a b)	(a b)
Silica (quartz).....short tons..	(b)	(b)	.....	.....
Silver.....troy ounces..	1,160	1,264	.....	.....
Stone.....short tons..	1,294,770	5,397,782	1,446,130	4,582,941
Talc.....do....	(b)	(b)	(b)	(b)
Miscellaneous.....	.....	7,506,202	.....	3,338,535
Total value, eliminating duplications.....	.....	12,411,708	.....	9,835,107

a Figures obtained through cooperation with Bureau of the Census.
b Value included under "Miscellaneous."
c Value not included in total value for State.

Mineral production of Michigan in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Bromine.....pounds..	1,046,165	$692,100	(a)	(a)
Calcium chloride.....short tons..	19,182	398,633	18,683	$431,402
Cement.....barrels..	4,442,455	10,939,633	5,680,156	10,300,289
Clay products.....	.....	6,572,316	.....	b 4,697,842
Clay, raw.....short tons..	5,066	c 11,295	692	c 2,355
Coal.....do....	1,489,765	7,346,000	1,141,715	5,555,000
Coke.....do....	1,393,445	c 15,731,994	777,125	c 7,050,191
Copper.....pounds..	154,695,073	28,463,893	86,370,028	11,141,734
Gems and precious stones.....	.....	(a)	.....	(a)
Grindstones.....short tons..	(a)	(a)	(a)	(a)
Gypsum.....do....	382,212	3,521,028	408,224	3,312,096
Iron ore:				
Sold to furnaces.....long tons..	18,862,578	85,749,217	5,011,804	18,481,225
Sold for paint.....do....	1,863	(a)	1,825	(a)
Iron, pig.....do....	464,197	c 16,812,062	200,944	c 5,955,205
Lime.....short tons..	140,813	1,386,760	48,164	445,386
Magnesium.....pounds..	(a)	(a)	.....	.....
Manganiferous ore.....long tons..	53,373	(a)	51	(a)
Mineral waters.....gallons sold..	1,227,485	122,010	1,344,900	154,401
Natural gas.....M cubic feet..	400	300	400	300
Peat.....short tons..	(a)	(a)	(a)	(a)
Potash (K_2O).....do....	49	18,312	.....	.....
Salt.....do....	2,262,915	10,698,674	1,427,465	7,439,445
Sand and gravel.....do....	4,386,582	2,867,466	5,515,253	3,015,296
Sand-lime brick.....thousands..	39,280	640,744	b 33,658	b 403,929
Silica (quartz).....short tons..	(a)	(a)	(a)	(a)
Silver.....troy ounces..	470,189	512,506	310,727	310,727
Stone.....short tons..	9,812,780	6,054,276	5,506,710	3,657,862
Miscellaneous.....	.....	354,950	.....	204,264
Total value, eliminating duplications.....	.....	166,338,818	.....	69,551,198

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.

Mineral production of Minnesota in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	b $3,341,477	.....	b c $2,482,286
Clay, raw.....short tons..	(a d)	(a d)	29,222	d 43,065
Coke.....do....	674,801	d 10,675,352	435,866	d 4,337,016
Flint lining for tube mills.....do....	(a)	(a)	(a)	(a)
Gems and precious stones.....	.....	67	.....	(a)
Iron ore:				
Sold to furnaces.....long tons..	39,747,594	163,538,054	17,648,603	62,780,754
Sold for paint.....do....	.....	.....	169	(a)
Iron, pig.....do....	340,190	(a d)	(a d)	(a d)
Lime.....short tons..	30,120	356,906	22,109	232,037
Manganiferous ore.....long tons..	542,437	1,611,946	56,530	(a)
Mineral waters.....gallons sold..	2,357,991	136,632	2,266,578	132,127
Peat.....short tons..	(a)	(a)	(a)	(a)
Pebbles for grinding.....do....	(a)	(a)	(a)	(a)
Sand and gravel.....do....	1,806,368	1,331,515	1,663,820	1,135,042
Sand-lime brick.....thousands..	24,891	290,394	(a c)	(a c)
Stone.....short tons..	685,810	3,149,751	c 362,850	e 2,034,368
Miscellaneous.....	.....	13,421,432	.....	7,178,554
Total value, eliminating duplications.....	.....	177,589,967	.....	72,609,973

a Value included under "Miscellaneous."
b Exclusive of pottery, value for which is included under "Miscellaneous."
c Figures obtained through cooperation with Bureau of the Census.
d Value not included in total value for State.
e Exclusive of basalt, value for which is included under "Miscellaneous."

Mineral production of Mississippi in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products		$1,075,752		[a] $737,967
Clay, raw, short tons	[b c]	[b c]	1,000	[c] 2,000
Mineral waters, gallons sold	136,175	31,312	140,600	31,945
Sand and gravel, short tons	1,770,981	1,090,949	2,455,405	1,183,197
Stone, do	[b]	[b]	[b]	[b]
Miscellaneous		21,573		1,244
Toral value, eliminating duplications		2,201,246		1,954,353

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Value included under "Miscellaneous."
[c] Value not included in total value for State.

Mineral production of Missouri in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Barytes, short tons	99,654	$1,013,570	25,200	$217,913
Briquets, fuel, do	[a b]	[a b]	[a b]	[a b]
Cement, barrels	5,605,952	10,980,453	4,375,712	8,034,540
Chats, short tons	1,113,522	[c] 501,000	1,730,473	[c] 260,000
Clay products		17,474,542		[d] 10,668,691
Clay, raw, short tons	448,984	[b] 1,413,189	256,783	[b] 938,135
Coal, do	5,369,565	22,230,000	3,551,621	13,915,500
Cobalt, do	51	262,801		
Coke, do	[a b]	[a b]	[a b]	[a b]
Copper, pounds	1,512,539	278,307	137,591	17,749
Iron ore, long tons	50,825	230,827	36,431	[a]
Iron, pig, do	81,682	[b] 3,678,623	17,028	[b] 479,957
Lead, short tons	165,114	26,418,240	180,085	16,207,650
Lime, do	209,113	2,319,285	159,194	1,656,560
Mineral paints, zinc and lead pigments, do	[a b]	[a b]	[a b]	[a b]
Mineral waters, gallons sold	323,628	50,892	176,541	45,670
Natural gas, M cubic feet	3,800	3,000	4,000	3,000
Nickel, short tons	138	103,361		
Petroleum, barrels	[a]	[a]	[a]	[a]
Potash (K_2O), short tons	6	1,081		
Pyrites, long tons	[a]	[a]		
Sand and gravel, short tons	1,909,314	1,356,352	1,539,073	1,018,325
Silver, troy ounces	111,128	121,130	69,902	69,902
Stone, short tons	1,457,960	3,518,387	1,385,250	2,978,575
Tripoli, do	[e]	[e]	[a]	[a]
Zinc, do	24,509	3,970,458	10,845	1,084,500
Miscellaneous		4,561,055		3,254,790
Total value, eliminating duplications		90,994,479		56,375,543

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Value estimated.
[d] Figures obtained through cooperation with Bureau of the Census.
[e] Includes production from Oklahoma. Not separable. Value included under "Miscellaneous."

Mineral production of Montana in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	$407,984	.....	b $175,386
Clay, raw.....short tons..	2,582	c 15,614	523	c 2,811
Coal.....do....	4,413,866	13,923,000	2,733,958	8,921,600
Copper.....pounds..	177,059,260	32,578,904	48,098,730	6,204,736
Ferroalloys.....long tons..	(a c)	(a c)	(a c)	(a c)
Gems and precious stones.....	.....	223,196	.....	489,021
Gold.....troy ounces..	89,550	1,851,165	71,632	1,480,763
Graphite, crystalline.....pounds..	(a)	(a)	.....	.....
Gypsum.....short tons..	(a)	(a)	(a)	(a)
Iron ore.....long tons..	10,803	73,889	26,174	91,729
Lead.....short tons..	15,627	2,500,313	10,183	916,511
Lime.....do....	2,638	30,020	(a)	(a)
Manganese ore.....long tons..	76,441	1,966,881	11,129	444,981
Mineral waters.....gallons sold..	(a)	(a)	(a)	(a)
Natural gas.....M cubic feet..	818,000	88,000	336,000	89,300
Petroleum.....barrels..	340,000	1,045,000	1,509,000	2,373,000
Phosphate rock.....long tons..	.....	.....	(a)	(a)
Sand and gravel.....short tons..	248,260	73,986	68,377	79,812
Silver.....troy ounces..	12,579,178	13,711,304	6,558,713	6,558,713
Stone.....short tons..	275,150	296,019	d 95,520	d 108,022
Sulphuric acid e.....do....	(a)	(a)	.....	.....
Zinc.....do....	92,169	14,931,361	11,638	1,163,798
Miscellaneous.....	.....	3,435,685	.....	1,064,375
Total value, eliminating duplications.....	.....	85,885,403	.....	30,161,734

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.
d Exclusive of basalt, value for which is included under "Miscellaneous."
e From copper smelting.

Mineral production of Nebraska in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	b $1,211,868	.....	b c $779,087
Clay, raw.....short tons..	(a d)	(a d)	55	d 350
Gems and precious stones.....	.....	(a)	.....	.....
Mineral paints, zinc and lead pigments.....short tons..	(a d)	(a d)	(a d)	(a d)
Potash (K_2O).....do....	20,397	3,919,534	337	33,700
Pumice.....do....	(a)	(a)	(a)	(a)
Sand and gravel.....do....	1,676,440	746,726	1,018,992	529,218
Stone.....do....	220,530	453,179	148,880	202,266
Miscellaneous.....	.....	852,661	.....	822,700
Total value, eliminating duplications.....	.....	7,168,424	.....	2,366,287

a Value included under "Miscellaneous."
b Exclusive of pottery, value for which is included under "Miscellaneous."
c Figures obtained through cooperation with Bureau of the Census.
d Value not included in total value for State.

Mineral production of Nevada in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Barytes.....short tons..	(a)	(a)		
Borates.....do....			200	$7,000
Clay products.....		(a)		(a b)
Clay, raw.....short tons..	(a c)	(a c)		
Copper.....pounds..	50,559,763	$9,302,996	10,961,491	1,414,032
Diatomaceous earth.....short tons..	(a)	(a)	(a)	(a)
Fluorspar.....do....	532	(a)		
Fuller's earth.....do....	(a)	(a)		
Gems and precious stones.....		12,920		5,538
Gold.....troy ounces..	172,540	3,566,728	160,255	3,312,757
Graphite, amorphous.....short tons..	(a)	(a)	(a)	(a)
Gypsum.....do....	143,929	1,100,261	178,275	1,533,037
Iron ore:				
Sold to furnaces.....long tons..	138	(a)		
Sold for paint.....do....	100	(a)	268	(a)
Lead.....short tons..	10,632	1,701,096	3,594	323,495
Lime.....do....	(a)	(a)	(a)	(a)
Manganese ore.....long tons..	1,240	21,673		
Manganiferous ore.....do....	95,142	286,440	14,871	(a)
Mineral waters.....gallons sold..	(a)	(a)	(a)	(a)
Pebbles for grinding.....short tons..	(a)	(a)	(a)	(a)
Quicksilver.....flasks..	83	6,612	(a)	(a)
Salt.....short tons..	(a)	(a)		
Sand and gravel.....do....	7,640	2,797	153,285	34,862
Silica (quartz).....do....	(a)	(a)		
Silver.....troy ounces..	7,745,093	8,442,151	7,083,782	7,083,782
Stone.....short tons..	(a)	(a)	(a)	(a)
Sulphur.....long tons..	(a)	(a)	(a)	(a)
Zinc.....short tons..	5,349	866,541	35	3,470
Miscellaneous.....		339,946		320,098
Total value, eliminating duplications.....		25,648,961		14,038,071

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.

Mineral production of New Hampshire in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products.....		$650,697		a $436,724
Feldspar (crude).....long tons..			(b)	(b)
Fluorspar.....short tons..	202	(b)	567	13,721
Garnet, abrasive.....do....	(b)	(b)	(b)	(b)
Gems and precious stones.....		(b)		
Mica:				
Scrap.....short tons..	435	12,877	537	10,613
Sheet.....pounds..	284,862	83,811	491,743	63,249
Millstones.....				(b)
Mineral waters.....gallons sold..	(b)	(b)	225,720	9,599
Peat.....short tons..	(b)	(b)	(b)	(b)
Sand and gravel.....do....	314,932	107,461	368,562	303,476
Scythestones.....do....	(b)	(b)	(b)	(b)
Stone.....do....	122,980	2,033,113	89,460	1,338,277
Miscellaneous.....		98,526		58,348
Total value, eliminating duplications.....		2,986,485		2,234,007

a Figures obtained through cooperation with Bureau of the Census and exclusive of pottery, value for which is included under "Miscellaneous."
b Value included under "Miscellaneous."

Mineral production of New Jersey in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Briquets, fuel.....short tons..	(a b)	(a b)	(a b)	(a b)
Cement.....barrels..	2,563,453	$5,096,558	2,840,699	$4,820,538
Clay products.....	.....	40,021,028	.....	c 27,214,685
Clay, raw.....short tons..	354,613	b 1,656,867	263,178	b 1,049,748
Coke.....do....	725,571	(a b)	739,768	(a b)
Ferroalloys.....long tons..	(a b)	(a b)	(a b)	(a b)
Gems and precious stones.....	.....	(a)	.....	.....
Iron ore:				
Sold to furnaces.....long tons..	417,100	2,595,949	115,132	551,688
Sold for paint.....do....	(a)	(a)	(a)	(a)
Iron, pig.....do....	88,408	b 3,380,145	(a b)	(a b)
Lime.....short tons..	3,301	27,407	1,818	14,365
Manganiferous residuum d.....long tons..	133,602	(a)	12,627	(a)
Marl, greensand.....short tons..	(a)	(a)	2,058	10,200
Mineral paints, zinc and lead pigments...do....	(a b)	(a b)	(a b)	(a b)
Mineral waters.....gallons sold..	702,867	68,036	250,295	25,960
Peat.....short tons..	26,623	281,527	12,051	94,269
Sand and gravel.....do....	4,616,444	4,330,844	3,568,780	2,436,298
Sand and sandstone (finely ground).....do....	(a)	(a)	(a)	(a)
Slate.....	.....	.....	.....	(a)
Stone.....short tons..	1,679,720	2,777,018	e 1,680,940	e 2,634,738
Sulphuric acid f.....do....	.....	.....	(a c)	(a c)
Talc.....do....	(a)	(a)	(a)	(a)
Zinc.....do....	77,371	(a)	56,447	(a)
Miscellaneous.....	.....	25,197,888	.....	17,055,005
Total value, eliminating duplications.....	.....	72,335,207	.....	47,429,290

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures obtained through cooperation with Bureau of the Census.
d Ore mined in New Jersey; smelted in Pennsylvania.
e Exclusive of serpentine, value for which is included under "Miscellaneous."
f From copper smelting.

Mineral production of New Mexico in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	$373,600	.....	a $267,698
Clay, raw.....short tons..	1,916	b 7,119	(b c)	(b c)
Coal.....do....	3,683,440	13,568,000	d 2,453,482	d 9,585,000
Coke.....do....	(b c)	(b c)	(b c)	(b c)
Copper.....pounds..	54,400,691	10,009,727	14,267,338	1,840,487
Fluorspar.....short tons..	6,353	101,460	3,507	60,186
Gems and precious stones.....	.....	1,315	.....	(c)
Gold.....troy ounces..	23,235	480,302	9,521	196,822
Gypsum.....short tons..	(c)	(c)	(c)	(c)
Iron ore.....long tons..	274,705	547,370	110,528	244,284
Lead.....short tons..	1,435	229,562	339	30,537
Lime.....do....	3,034	34,680	3,044	33,660
Lithium minerals.....do....	.....	.....	(c)	(c)
Manganese ore.....long tons..	2,053	32,107	.....	.....
Manganiferous ore.....do....	19,800	98,343	300	(c)
Mica, scrap.....short tons..	(c)	(c)	(c)	(c)
Mineral paints, zinc and lead pigments...do....	(b c)	(b c)	(b c)	(b c)
Mineral waters.....gallons sold..	(c)	(c)	(c)	(c)
Molybdenum.....pounds..	34,900	17,207	.....	.....
Petroleum.....barrels..	(c)	(c)	(c)	(c)
Salt.....short tons..	(c)	(c)	(c)	(c)
Sand and gravel.....do....	209,193	128,815	327,345	168,895
Silver.....troy ounces..	768,042	837,166	571,899	571,899
Stone.....short tons..	331,690	297,271	39,640	52,356
Zinc.....do....	5,007	811,100	114	11,400
Miscellaneous.....	.....	2,549,910	.....	474,656
Total value, eliminating duplications.....	.....	27,883,565	.....	13,227,268

a Figures obtained through cooperation with Bureau of the Census.
b Value not included in total value for State.
c Value included under "Miscellaneous."
d Exclusive of 3,460 tons produced at small mines, value for which is included under "Miscellaneous."

Mineral production of New York in 1920 and 1921.

Product.		1920		1921	
		Quantity.	Value.	Quantity.	Value.
Aluminum	pounds	(a b)	(a b)	(a b)	(a b)
Briquets, fuel	short tons	(a b)	(a b)	(a b)	(a b)
Cement	barrels	c 6,049,150	c $12,206,698	c 4,993,341	c $9,403,015
Clay products			19,113,684		d 17,432,086
Clay, raw	short tons	8,545	b 43,672	4,247	b 16,423
Coke	do	1,040,192	b 12,066,227	746,916	b 5,151,865
Diatomaceous earth	do	(a)	(a)	(a)	(a)
Emery	do	1,596	14,375	(a)	(a)
Feldspar (crude)	long tons	19,294	121,027	(a)	(a)
Ferroalloys	do	73 887	b 9,851,373	29,401	b 2,377,776
Garnet, abrasive	short tons	4,276	359,425	2,998	258,705
Gems and precious stones			(a)		
Graphite:					
Artificial	pounds	7,399,749	(a b)	5,888,000	(a b)
Crystalline	do	(a)	(a)	(a)	(a)
Gypsum	short tons	780,295	6,438,929	712,665	6,410,221
Iron ore:					
Sold to furnaces	long tons	959,408	6,263,252	174,368	946,366
Sold for paint	do	13,501	(a)	2,445	(a)
Iron, pig	do	2,415,627	b 89,416,703	786,713	b 18,212,810
Lime	short tons	92,357	1,047,261	67,685	759,299
Magnesium	pounds	(a b)	(a b)	10,044	(a b)
Marl, calcareous	short tons	10,950	7,834	800	4,928
Millstones			13,331		14,672
Mineral waters	gallons sold	5,242,047	671,066	5,965,049	736,173
Natural gas	M cubic feet	8,419,000	3,195,000	6,583,000	2,798,000
Natural-gas gasoline	gallons	411,078	75,576	366,240	52,108
Peat	short tons	(a)	(a)	841	7,200
Petroleum	barrels	906,000	5,433,000	988,000	3,262,000
Potash (K_2O)	short tons	(a)	(a)	(a)	(a)
Pyrites	long tons	30,753	261,575	(a)	(a)
Salt	short tons	1,903,101	7,584,921	1,455,014	6,505,041
Sand and gravel	do	6,127,018	4,338,457	6,021,229	3,673,127
Sand-lime brick	thousands	11,294	176,114	(a d)	(a d)
Silica (quartz)	short tons	(a)	(a)	(a)	(a)
Slate			911,293		516,956
Stone	short tons	5,969,730	8,014,446	5,809,140	8,705,331
Talc	do	68,168	977,228	41,937	530,154
Zinc	do	5,654	915,948	1,572	157,200
Miscellaneous			25,085,648		6,632,311
Total value, eliminating duplications			78,431,317		62,567,967

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Exclusive of natural cement, value for which is included under "Miscellaneous."
d Figures obtained through cooperation with Bureau of the Census.

Mineral production of North Carolina in 1920 and 1921.

Product.		1920		1921	
		Quantity.	Value.	Quantity.	Value.
Aluminum	pounds	(a b)	(a b)	(a b)	(a b)
Barytes	short tons	(a)	(a)	(a)	(a)
Clay products			$3,884,988		c $2,289,523
Clay, raw	short tons	15,679	b 244,695	11,712	b 188,862
Coal	do	11,540	81,000	23,438	135,000
Feldspar (crude)	long tons	36,521	187,136	40,712	259,603
Gems and precious stones			(a)		(a)
Gold	troy ounces	55	1,147	154	3,179
Iron ore	long tons	71,810	293,382	383	(a)
Lime	short tons	(a)	(a)	(a)	(a)
Marl, calcareous	do	13,000	52,000	1,482	4,446
Mica:					
Scrap	do	2,823	91,653	1,353	30,496
Sheet	pounds	1,084,946	405,654	230,532	51,851
Millstones			14,226		(a)
Mineral waters	gallons sold	115,315	15,545	87,052	13,561
Peat	short tons	(a)	(a)	(a)	(a)
Sand and gravel	do	520,125	403,793	711,382	485,834
Silica (quartz)	do	(a)	(a)	(a)	(a)
Silver	troy ounces	10	11	18	18
Stone	short tons	d 672,810	d 2,088,266	730,690	2,087,879
Talc	do	2,267	75,474	731	17,018
Miscellaneous			10,510,091		2,793,635
Total value, eliminating duplications			7,760,482		5,456,479

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures obtained through cooperation with Bureau of the Census.
d Exclusive of marble, value for which is included under "Miscellaneous."

Mineral production of North Dakota in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Briquets, fuel.....short tons..	(a b)	(a b)	.....	.....
Clay products.....	.....	$350,548	.....	c $160,949
Clay, raw.....short tons..	(a b)	(a b)	16	b 183
Coal.....do....	948,625	2,724,000	864,903	2,329,500
Mineral waters.....gallons sold..	(a)	(a)	585,000	8,100
Natural gas.....M cubic feet..	1,100	300	1,000	400
Sand and gravel.....short tons..	(a)	(a)	(a)	(a)
Sand-lime brick.....thousands..	30	500	.....	.....
Miscellaneous.....	.....	13,146	.....	1,400
Total value, eliminating duplications.....	.....	3,078,548	.....	2,500,349

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures obtained through cooperation with Bureau of the Census.

Mineral production of Ohio in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Bromine.....pounds..	(a)	(a)	.....	.....
Calcium chloride.....short tons..	(a)	(a)	1,030	$18,854
Cement.....barrels..	b 1,670,958	b $3,561,490	b 2,518,723	b 4,615,492
Clay products.....	.....	82,061,960	.....	c 67,396,680
Clay, raw.....short tons..	311,806	d 729,617	150,902	d 277,514
Coal.....do....	45,878,191	175,081,000	31,942,776	84,686,500
Coke.....do....	5,701,810	d 53,242,020	3,028,423	d 16,272,453
Ferroalloys.....long tons..	79,208	d 3,963,635	17,490	d 566,780
Grindstones and pulpstones.....short tons..	42,385	1,310,445	19,987	870,130
Gypsum.....do....	277,899	2,161,038	363,905	3,191,937
Iron, pig.....long tons..	8,229,770	d 246,326,276	3,649,835	d 88,473,082
Lime.....short tons..	558,892	6,238,908	471,053	4,224,579
Marl, calcareous.....do....	410	1,743	(a)	(a)
Mineral paints, zinc and lead pigments....do....	.....	.....	(a d)	(a d)
Mineral waters.....gallons sold..	2,337,437	169,400	2,219,149	161,208
Natural gas.....M cubic feet..	58,938,000	21,587,000	47,412,000	19,216,000
Natural-gas gasoline.....gallons..	10,015,638	2,194,558	9,099,897	1,546,551
Oilstones and scythestones.....short tons..	213	26,785	309	38,317
Petroleum.....barrels..	7,400,000	37,338,000	7,335,000	21,512,000
Potash (K_2O).....short tons..	31	6,515	.....	.....
Salt.....do....	1,057,802	3,324,492	749,349	3,284,952
Sand and gravel.....do....	6,665,819	6,434,627	5,138,276	4,060,486
Sand-lime brick.....thousands..	8,350	120,075	(a c)	(a c)
Stone.....short tons..	9,105,630	10,856,468	7,229,150	8,563,522
Sulphuric acid e.....do....	(a)	(a)	(a c)	(a c)
Miscellaneous.....	.....	3,369,995	.....	587,636
Total value, eliminating duplications.....	.....	355,844,499	.....	223,533,658

a Value included under "Miscellaneous."
b Exclusive of natural cement, value for which is included under "Miscellaneous".
c Figures obtained through cooperation with Bureau of the Census.
d Value not included in total value for State.
e From zinc smelting.

Mineral production of Oklahoma in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	152,087	$1,758,701	151,134	$1,446,083
Cement.....barrels..	1,484,698	3,284,412	1,596,566	3,420,093
Clay products.....	.....	2,769,013	.....	[a] 1,796,666
Coal.....short tons..	4,849,288	23,294,000	3,362,623	15,546,000
Gypsum.....do....	135,279	816,768	209,201	1,289,226
Lead.....do....	65,394	10,463,040	41,552	3,739,680
Lime.....do....	[b]	[b]	[b]	[b]
Mineral paints, zinc and lead pigments.....do....	[b c]	[b c]	[b c]	[b c]
Mineral waters.....gallons sold..	1,437,810	49,287	1,319,895	45,078
Natural gas.....M cubic feet..	154,467,200	25,805,000	124,058,000	23,429,000
Natural-gas gasoline.....gallons..	178,856,929	31,334,493	185,340,742	22,066,014
Petroleum.....barrels..	106,206,000	356,439,000	114,634,000	183,185,000
Sand and gravel.....short tons..	875,677	626,099	881,849	686,507
Stone.....do....	875,560	1,056,136	[d] 878,350	[d] 1,023,514
Tripoli.....do....	[e]	[c]	[b]	[b]
Zinc.....do....	219,727	35,595,774	121,372	12,137,200
Miscellaneous.....	.....	571,929	.....	161,375
Total value, eliminating duplications.....	.....	493,320,359	.....	269,882,786

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Value included under "Miscellaneous."
[c] Value not included in total value for State.
[d] Exclusive of sandstone, value for which is included under "Miscellaneous."
[e] Included in Missouri figures. Not separable.

Mineral production of Oregon in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Briquets, fuel.....short tons..	[a b]	[a b]	[a b]	[a b]
Cement.....barrels..	[a]	[a]	[a]	[a]
Chromite.....long tons..	955	$7,486	159	$1,614
Clay products.....	.....	[c] 719,486	.....	[c d] 471,472
Clay, raw.....short tons..	[a b]	[a b]	224	[b] 857
Coal.....do....	20,717	93,000	[a]	[a]
Copper.....pounds..	2,355,276	433,371	174,300	22,485
Diatomaceous earth.....short tons..	.....	.....	[a]	[a]
Gems and precious stones.....	.....	2,475	.....	[a]
Gold.....troy ounces..	49,221	1,017,490	42,668	882,034
Gypsum.....short tons..	[a]	[a]	[a]	[a]
Lime.....do....	[a]	[a]	[a]	[a]
Mineral waters.....gallons sold..	2,360	701	2,150	653
Natural gas.....M cubic feet..	200	100	200	100
Platinum and allied metals.....troy ounces..	11	2,101	73	6,830
Quicksilver.....flasks..	24	1,912	[a]	[a]
Sand and gravel.....short tons..	1,245,502	1,028,253	1,351,425	1,079,815
Silver.....troy ounces..	82,743	90,190	42,120	42,120
Stone.....short tons..	805,950	1,030,220	804,550	1,074,596
Miscellaneous.....	.....	1,619,686	.....	2,191,582
Total value, eliminating duplications.....	.....	5,496,253	.....	5,199,803

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Exclusive of pottery, value for which is included under "Miscellaneous."
[d] Figures obtained through cooperation with Bureau of the Census.

Mineral production of Pennsylvania in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Briquets, fuel.....short tons..	182,389	[a] $1,021,372	66,352	[a] $407,570
Cement.....barrels.	[b] 27,662,116	[b] 52,632,082	[b] 26,622,367	[b] 46,881,625
Clay products.....	.....	50,983,988	.....	[c] 32,164,172
Clay, raw.....short tons..	603,000	[a] 2,332,225	254,179	[a] 895,394
Coal:				
Anthracite.....do....	89,598,249	434,252,198	90,473,451	452,304,903
Bituminous.....do....	170,607,847	642,630,000	116,013,942	322,538,300
Coke.....do....	23,638,739	[a] 217,666,031	9,769,476	[a] 44,111,831
Copper.....pounds..	405,092	74,537	313,302	40,416
Feldspar (crude).....long tons..	7,645	43,649	(d)	(d)
Ferroalloys.....do....	340,743	[a] 50,169,570	161,198	[a] 14,581,323
Gems and precious stones.....	.....	(d)	.....	(d)
Graphite, crystalline.....pounds..	(d)	(d)	.....	.....
Iron ore:				
Sold to furnaces.....long tons..	719,813	1,406,929	187,062	288,955
Sold for paint.....do....	(d)	(d)	2,709	(d)
Iron, pig.....do....	13,472,814	[a] 448,251,415	6,072,196	[a] 148,350,285
Lead.....short tons..	7	1,176	.....	.....
Lime.....do....	784,083	7,519,147	509,891	4,247,509
Marl, calcareous.....do....	.....	.....	1,000	6,590
Mineral paints, zinc and lead pigments....do....	(a d)	(a d)	(a d)	(a d)
Mineral waters.....gallons sold..	641,440	66,945	730,252	74,490
Natural gas.....M cubic feet..	125,787,000	40,726,000	86,144,000	32,815,000
Natural-gas gasoline.....gallons..	21,151,135	4,382,380	19,856,373	3,354,233
Pebbles for grinding.....short tons..	(d)	(d)	.....	.....
Petroleum.....barrels..	7,438,000	44,464,000	7,418,000	24,746,000
Potash (K_2O).....short tons..	109	16,823	47	4,717
Pyrites.....long tons..	(d)	(d)	(d)	(d)
Sand and gravel.....short tons..	6,421,739	8,347,271	6,640,334	7,600,711
Sand and sandstone (finely ground).....do....	(d)	(d)	(d)	(d)
Sand-lime brick.....thousands..	10,840	154,983	(c d)	(c d)
Silica (quartz).....short tons..	(d)	(d)	(d)	(d)
Silver.....troy ounces..	90	98	.....	.....
Slate.....	.....	3,850,267	.....	3,595,386
Stone.....short tons..	[e] 14,296,630	[e] 20,615,316	9,022,650	12,378,202
Sulphuric acid (60° Baumé)[f].....do....	[g] 101,755	1,599,917	[c h] 98,766	[c h] 1,271,000
Talc.....do....	(d)	(d)	(d)	(d)
Tripoli (rottenstone).....do....	(d)	(d)	(d)	(d)
Miscellaneous.....	.....	17,459,857	.....	10,339,646
Total value, eliminating duplications.....	.....	1,314,332,585	.....	944,688,650

[a] Value not included in total value for State.
[b] Exclusive of natural cement, value for which is included under "Miscellaneous."
[c] Figures obtained through cooperation with Bureau of the Census.
[d] Value included under "Miscellaneous".
[e] Exclusive of marble, value for which is included under "Miscellaneous."
[f] From zinc smelting.
[g] Includes several thousand tons of stronger acid not converted to 60° Baumé.
[h] Figures represent production, the value having been partly estimated by Geological Survey to cover acid consumed by producer as well as that sold.

Mineral production of Rhode Island in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	(a)	.....	(a b)
Coke.....short tons..	(a c)	(a c)	(a c)	(a c)
Graphite, amorphous.....do....	(a)	(a)	(a)	(a)
Lime.....do....	(a)	(a)	(a)	(a)
Mineral waters.....gallons sold..	370,315	$21,946	327,352	$21,391
Sand and gravel.....short tons..	17,979	29,542	11,364	15,590
Stone.....do....	[d] 123,470	[d] 786,815	[d] 126,590	[d] 609,999
Miscellaneous.....	.....	1,820,442	.....	1,391,599
Total value, eliminating duplications.....	.....	1,175,653	.....	922,765

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value not included in total value for State.
[d] Exclusive of limestone, value for which is included under "Miscellaneous."

Mineral production of South Carolina in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Barytes.....short tons..	(a)	(a)	(a)	(a)
Clay products.....	.....	$1,272,147	.....	b 8689,663
Clay, raw.....short tons..	50,131	c 462,819	35,891	c 273,892
Gold.....troy ounces..	16	332	2	50
Marl, calcareous.....short tons..	(a)	(a)	(a)	(a)
Mineral waters.....gallons sold..	246,418	51,112	124,055	18,489
Phosphate rock.....long tons..	44,141	367,209	.....	.....
Sand and gravel.....short tons..	263,630	186,045	330,669	154,661
Silver.....troy ounces..	1	1	.....	.....
Stone.....short tons..	272,460	860,000	427,140	882,267
Miscellaneous.....	.....	88,633	.....	9,361
Total value, eliminating duplications.....	.....	2,825,479	.....	1,754,491

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.

Mineral production of South Dakota in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	$69,237	.....	(a b)
Clay, raw.....short tons..	(b c)	(b c)	900	c $9,000
Coal.....do....	12,777	46,000	7,553	21,200
Columbite.....pounds..	4,000	1,450	3,400	1,150
Gems and precious stones.....	.....	(b)	.....	335
Gold.....troy ounces..	226,224	4,676,470	319,525	6,605,167
Gypsum.....short tons..	(b)	(b)	(b)	(b)
Lead.....do....	6	1,025	2	180
Lime.....do....	(b)	(b)	(b)	(b)
Lithium minerals.....do....	(b)	(b)	(b)	(b)
Mica, scrap.....do....	(b)	(b)	92	2,290
Mineral waters.....gallons sold..	(b)	(b)	(b)	(b)
Natural gas.....M cubic feet..	20,000	12,000	9,700	4,000
Sand and gravel.....short tons..	572,259	253,614	185,639	136,152
Sand-lime brick.....thousands..	(b)	(b)	(a b)	(a b)
Silver.....troy ounces..	99,795	98,966	112,464	112,464
Stone.....short tons..	196,880	489,753	181,600	386,906
Tin (metallic equivalent).....do....	6	6,000	.....	.....
Miscellaneous.....	.....	302,363	.....	228,812
Total value, eliminating duplications.....	.....	5,950,878	.....	7,498,656

a Figures obtained through cooperation with Bureau of the Census.
b Value included under "Miscellaneous."
c Value not included in total value for State.

Mineral production of Tennessee in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Aluminum.....pounds..	(a b)	(a b)	(a b)	(a b)
Barytes.....short tons..	29,319	$213,657	8,180	$61,148
Bauxite.....long tons..	(a)	(a)	(a)	(a)
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	4,446,686	.....	c 2,971,448
Clay, raw.....short tons..	110,479	b 603,374	52,929	b 287,409
Coal.....do....	6,662,428	26,778,000	4,460,326	14,932,000
Coke.....do....	301,708	b 2,928,557	85,728	b 459,469
Copper.....pounds..	16,727,803	3,077,916	15,084,294	1,945,874
Ferroalloys.....long tons..	52,683	b 3,126,143	13,808	b 780,713
Gold.....troy ounces..	282	5,830	238	4,920
Iron ore:				
Sold to furnaces.....long tons..	373,012	1,355,217	25,219	68,726
Sold for paint.....do....	(a)	(a)	(a)	(a)
Iron, pig.....do....	217,887	b 9,271,324	21,972	b 595,850
Lead.....short tons..	1,979	316,560	.....	.....
Lime.....do....	119,034	1,098,603	93,397	733,639
Manganese ore.....long tons..	502	16,436	139	3,396
Manganiferous ore.....do....	.....	.....	24	257
Mineral waters.....gallons sold..	1,265,286	73,570	1,150,585	72,227
Natural gas.....M cubic feet..	15,000	3,000	11,000	2,600
Petroleum.....barrels..	14,000	50,000	12,400	21,400
Phosphate rock.....long tons..	621,396	4,857,399	264,159	1,720,819
Potash (K_2O).....short tons..	.....	.....	(a)	(a)
Pyrites.....long tons..	(a)	(a)	(a)	(a)
Sand and gravel.....short tons..	1,117,245	1,012,357	1,095,114	930,767
Sand-lime brick.....thousands..	.....	.....	(a c)	(a c)
Silica (quartz).....short tons..	(a)	(a)	.....	.....
Silver.....troy ounces..	110,719	120,684	98,762	98,762
Slate.....	.....	.....	.....	(a)
Stone.....short tons..	1,098,660	2,962,725	d 940,170	d 2,707,025
Sulphuric acid e.....do....	(a)	(a)	(a c)	(a c)
Zinc.....do....	19,217	3,113,154	9,692	969,200
Miscellaneous.....	.....	12,389,656	.....	8,909,935
Total value, eliminating duplications.....	.....	55,023,232	.....	33,754,823

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures obtained through cooperation with Bureau of the Census.
d Exclusive of sandstone, value for which is included under "Miscellaneous."
e From copper smelting.

Mineral production of Texas in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	261,465	$3,838,295	270,761	$2,870,583
Cement.....barrels..	2,626,130	5,898,972	2,514,045	5,902,863
Clay products.....	.....	6,298,407	.....	a 3,976,136
Clay, raw.....short tons..	3,478	b 23,503	2,370	b 11,099
Coal.....do....	1,615,015	6,062,000	972,839	2,563,600
Copper.....pounds..	14,435	2,656	.....	.....
Fuller's earth.....short tons..	(c)	(c)	8,797	127,408
Gems and precious stones.....	.....	(c)	.....	(c)
Graphite, crystalline.....pounds..	(c)	(c)	(c)	(c)
Gypsum.....short tons..	220,157	1,439,491	232,806	1,765,600
Iron ore.....long tons..	.....	.....	131	(c)
Lime.....short tons..	56,489	569,135	44,404	452,078
Mica:				
Scrap.....do....	427	8,995	.....	.....
Sheet.....pounds..	(c)	(c)	.....	.....
Mineral waters.....gallons sold..	597,233	91,983	366,429	67,410
Natural gas.....M cubic feet..	37,063,000	7,042,000	44,504,000	8,893,000
Natural-gas gasoline.....gallons..	32,956,028	5,770,809	77,141,201	9,118,420
Petroleum.....barrels..	96,868,000	313,781,000	106,166,000	162,663,000
Quicksilver.....flasks..	3,436	273,712	(c)	(c)
Salt.....short tons..	91,103	667,835	(c)	(c)
Sand and gravel.....do....	2,849,309	2,676,883	2,970,568	1,847,741
Sand-lime brick.....thousands..	7,125	113,533	(a c)	(a c)
Silver.....troy ounces..	511,401	557,427	355,109	355,109
Stone.....short tons..	680,450	890,316	1,045,320	1,242,806
Sulphur.....long tons..	(c)	(c)	(c)	(c)
Miscellaneous.....	.....	15,267,530	.....	10,295,496
Total value, eliminating duplications.....	.....	371,250,979	.....	212,141,250

a Figures obtained through cooperation with Bureau of the Census.
b Value not included in total value for State.
c Value included under "Miscellaneous."

Mineral production of Utah in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	63,522	$659,176	10,371	$190,808
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	b 1,107,204	.....	b c 1,057,678
Clay, raw.....short tons..	3,814	d 16,337	3,086	d 13,791
Coal.....do....	6,005,199	19,350,000	e 4,078,784	e 13,662,000
Coke.....do....	(a d)	(a d)	(a d)	(a d)
Copper.....pounds..	116,931,238	21,515,348	30,891,403	[illegible]
Diatomaceous earth.....short tons..	(a)	(a)	(a)	(a)
Fluorspar.....do....	268	(a)	.....	.....
Gems and precious stones.....	.....	(a)	.....	820
Gold.....troy ounces..	97,454	2,014,556	85,619	1,769,905
Gypsum.....short tons..	(a)	(a)	35,536	243,222
Iron ore.....long tons..	36,159	151,174	60,773	156,865
Lead.....short tons..	70,419	11,267,049	44,594	4,013,427
Lime.....do....	9,797	151,700	7,972	104,605
Manganiferous ore.....long tons..	66	(a)	.....	.....
Petroleum.....barrels..	(a)	(a)	.....	.....
Phosphate rock.....long tons..	1,875	12,000	.....	.....
Potash (K_2O).....short tons..	7,738	1,001,678	1,470	153,644
Salt.....do....	75,259	546,186	68,874	491,354
Sand and gravel.....do....	519,655	252,527	527,403	162,944
Silver.....troy ounces..	13,106,976	14,286,604	12,251,998	12,251,998
Sodium sulphate from natural sources .....short tons..	.....	.....	(a)	(a)
Stone.....do....	304,290	509,740	f 374,010	f 483,773
Sulphur.....long tons..	.....	.....	(a)	(a)
Sulphuric acid g.....short tons..	(a)	(a)	(a c)	(a c)
Uranium and vanadium ores.....do....	1,491	104,033	53	5,440
Zinc.....do....	4,079	660,777	35	3,469
Miscellaneous.....	.....	4,811,691	.....	3,132,601
Total value, eliminating duplications.....	.....	76,536,657	.....	40,595,872

a Value included under "Miscellaneous."
b Exclusive of pottery, value for which is included under "Miscellaneous."
c Figures obtained through cooperation with Bureau of the Census.
d Value not included in total value for State.
e Exclusive of 11,611 tons produced at small mines, value for which is included under "Miscellaneous."
f Exclusive of marble, value for which is included under "Miscellaneous."
g From copper smelting.

Mineral production of Vermont in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	$186,752	.....	(a b)
Clay, raw.....short tons..	4,716	c 52,697	2,560	c $35,210
Lime.....do....	50,192	716,137	32,782	460,318
Mineral waters.....gallons sold..	88,398	11,079	4,500	468
Sand and gravel.....short tons..	41,388	6,856	38,752	13,740
Scythestones.....do....	(b)	(b)	(b)	(b)
Slate.....	.....	3,182,477	.....	2,346,978
Stone.....short tons..	301,980	10,065,759	202,630	7,322,843
Talc.....do....	86,489	816,794	48,648	438,534
Miscellaneous.....	.....	23,040	.....	67,332
Total value, eliminating duplications.....	.....	15,008,894	.....	10,650,213

a Figures obtained through cooperation with Bureau of the Census.
b Value included under "Miscellaneous."
c Value not included in total value for State.

Mineral production of Virginia in 1920 and 1921.

Product.		1920		1921	
		Quantity.	Value.	Quantity.	Value.
Barytes	short tons	(a)	(a)	(a)	(a)
Briquets, fuel	do	(a b)	(a b)	(a b)	(a b)
Cement	barrels	(a)	(a)	(a)	(a)
Clay products			$3,335,222		c $2,563,883
Clay, raw	short tons	12,094	b 131,883	9,430	b 92,730
Coal	do	11,378,606	45,446,000	7,492,378	22,947,700
Coke	do	1,027,788	b 9,106,202	280,476	b 2,029,652
Diatomaceous earth	do			(a)	(a)
Emery	do	(a)	(a)	(a)	(a)
Ferroalloys	long tons	(a b)	(a b)	(a b)	(a b)
Gems and precious stones			(a)		
Gold	troy ounces			37	763
Gypsum	short tons	(a)	(a)	(a)	(a)
Iron ore	long tons	320,109	1,227,601	54,353	196,935
Iron, pig	do	390,372	b 16,086,946	66,916	b 2,023,268
Lime	short tons	256,568	2,201,724	111,518	1,005,677
Manganese ore	long tons	2,523	73,929	717	15,549
Marl, calcareous	short tons	42,510	143,373	33,978	105,821
Mica:					
Scrap	do	(a)	(a)	(a)	(a)
Sheet	pounds	179,339	26,189	(a)	(a)
Millstones			34,676		(a)
Mineral paints, zinc and lead pigments	short tons	(a b)	(a b)		
Mineral waters	gallons sold	1,248,382	147,600	902,034	122,283
Potash (K_2O)	short tons			(a)	(a)
Pyrites	long tons	100,545	610,085	(a)	(a)
Salt	short tons	(a)	(a)	(a)	(a)
Sand and gravel	do	1,213,827	1,133,279	1,048,293	958,527
Silver	troy ounces			8	8
Slate			251,055		212,943
Stone	short tons	1,466,920	1,796,620	1,379,300	1,557,668
Talc and soapstone	do	21,715	729,767	17,721	601,878
Titanium minerals:					
Ilmenite	do	268	(a)		
Rutile	do	277	(a)		
Miscellaneous			5,075,583		2,845,657
Total value, eliminating duplications			60,161,247		32,810,842

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures obtained through cooperation with Bureau of the Census.

Mineral production of Washington in 1920 and 1921.

Product.		1920		1921	
		Quantity.	Value.	Quantity.	Value.
Briquets, fuel	short tons	(a b)	(a b)	(a b)	(a b)
Cement	barrels	1,806,025	$4,096,227	1,612,891	$4,080,785
Clay products			2,923,687		c 1,496,741
Clay, raw	short tons	1,319	b 10,377	439	b 5,153
Coal	do	3,757,093	14,560,000	2,428,722	9,787,000
Coke	do	59,395	b 627,451	27,260	b 194,510
Copper	pounds	1,983,134	364,897	251,544	32,449
Diatomaceous earth	short tons	953	12,083	(a)	(a)
Ferroalloys	long tons	(a b)	(a b)	(a b)	(a b)
Gems and precious stones					(a)
Gold	troy ounces	5,847	120,860	6,216	128,486
Iron ore	long tons	2,500	(a)		
Lead	short tons	2,894	462,980	72	6,460
Lime	do	31,033	324,042	17,710	209,761
Magnesite	do	221,985	1,664,888		
Mineral waters	gallons sold	(a)	(a)	(a)	(a)
Platinum	troy ounces	8	888		
Sand and gravel	short tons	1,976,969	1,016,926	1,481,574	881,842
Sand-lime brick	thousands	(a)	(a)		
Silica (quartz)	short tons			(a)	(a)
Silver	troy ounces	199,678	217,649	142,450	142,450
Stone	short tons	712,680	821,842	542,490	789,364
Zinc	do	213	34,546	225	22,468
Miscellaneous			528,765		159,088
Total value, eliminating duplications			26,677,191		17,605,878

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures obtained through cooperation with Bureau of the Census.

Mineral production of West Virginia in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Bromine.....pounds..	94,943	$38,749	49,717	$5,081
Calcium chloride.....short tons..	4,877	79,493	2,959	48,467
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	17,167,843	.....	b 13,736,172
Clay, raw.....short tons..	86,360	c 211,029	25,244	c 42,595
Coal.....do....	89,970,707	390,046,000	72,786,996	206,661,500
Coke.....do....	1,828,336	c 16,874,508	397,892	c 2,253,044
Ferro alloys.....long tons..	(a c)	(a c)	(a c)	(a c)
Grindstones and pulpstones.....short tons..	9,426	346,872	5,497	330,582
Iron, pig.....long tons..	489,689	c 15,927,822	259,312	c 6,557,498
Lime.....short tons..	193,490	1,813,666	119,716	1,015,690
Marl, calcareous.....do....	(a)	(a)	(a)	(a)
Mineral waters.....gallons sold..	392,950	39,180	412,595	37,205
Natural gas.....M cubic feet..	239,718,800	67,259,900	174,920,800	52,827,900
Natural-gas gasoline.....gallons..	58,941,488	13,049,551	54,646,053	9,889,861
Petroleum.....barrels..	8,249,000	50,146,000	7,822,000	26,482,000
Salt.....short tons..	29,802	348,556	27,964	320,537
Sand and gravel.....do....	1,547,805	2,513,534	1,374,679	2,039,042
Sand and sandstone (finely ground).....do....	(a)	(a)	(a)	(a)
Stone.....do....	2,459,030	3,155,942	1,609,200	1,702,097
Sulphuric acid d.....do....	(a)	(a)	(a b)	(a b)
Miscellaneous.....	.....	3,729,565	.....	1,348,285
Total value, eliminating duplications.....	.....	547,872,937	.....	316,180,647

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.
d From zinc smelting.

Mineral production of Wisconsin in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Barytes.....short tons..	(a)	(a)	.....	.....
Briquets, fuel.....do....	(a b)	(a b)	(a b)	(a b)
Clay products.....	.....	c $1,413,255	.....	c d $765,644
Clay, raw.....short tons..	(a b)	(a b)	160	b 480
Coke.....do....	(a b)	(a b)	(a b)	(a b)
Iron ore:				
Sold to furnaces.....long tons..	1,067,159	4,333,307	117,755	300,954
Sold for paint.....do....	1,645	(a)	1,455	3,411
Iron, pig.....do....	363,588	b 12,355,028	93,666	b 2,730,155
Lead.....short tons..	2,647	423,520	972	87,480
Lime.....do....	144,590	1,539,027	124,078	999,407
Mica, sheet.....pounds..	.....	.....	(a)	(a)
Mineral paints, zinc and lead pigments .....short tons..	(a b)	(a b)	(a b)	(a b)
Mineral waters.....gallons sold..	5,259,447	1,601,075	5,665,797	1,726,333
Peat.....short tons..	(a)	(a)	(a)	(a)
Potash (K_2O).....do....	181	119,542	(a)	(a)
Pyrites.....long tons..	(a)	(a)	(a)	(a)
Sand and gravel.....short tons..	2,422,689	1,553,622	2,899,809	1,783,178
Sand-lime brick.....thousands..	17,157	215,988	(a d)	(a d)
Silica (quartz).....short tons..	(a)	(a)	(a)	(a)
Stone.....do....	1,564,940	3,729,236	e 1,743,770	e 3,569,929
Sulphuric acid f.....do....	(a)	(a)	(a d)	(a d)
Zinc.....do....	27,285	4,420,170	3,390	339,000
Miscellaneous.....	.....	12,234,975	.....	6,303,364
Total value, eliminating duplications.....	.....	19,630,114	.....	9,990,961

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Exclusive of pottery, value for which is included under "Miscellaneous."
d Figures obtained through cooperation with Bureau of the Census.
e Exclusive of basalt, value for which is included under "Miscellaneous."
f From zinc smelting.

Mineral production of Wyoming in 1920 and 1921.

Product.	1920		1921	
	Quantity.	Value.	Quantity.	Value.
Asbestos.....short tons..	(a)	(a)	.....	.....
Chromite.....long tons..	131	$3,684	.....	.....
Clay products.....	.....	258,706	.....	b $252,401
Clay, raw.....short tons..	(a c)	(a c)	433	c 2,155
Coal.....do....	9,630,271	28,741,000	7,200,666	23,358,500
Copper.....pounds..	.....	.....	10,000	1,290
Gems and precious stones.....	.....	(a)	.....	(a)
Gold.....troy ounces..	.....	.....	3	62
Gypsum.....short tons..	57,732	410,724	38,927	224,258
Iron ore.....long tons..	406,501	(a)	234,701	(a)
Lime.....short tons..	(a)	(a)	(a)	(a)
Manganese ore.....long tons..	40	2,800	.....	.....
Mineral waters.....gallons sold..	8,576	1,350	(a)	(a)
Natural gas.....M cubic feet..	10,312,000	805,000	15,608,000	1,715,000
Natural-gas gasoline.....gallons..	8,711,037	1,735,828	14,557,684	1,599,591
Petroleum.....barrels..	16,831,000	50,050,000	19,332,800	23,528,000
Potash (K_2O).....short tons..	(a)	(a)	.....	.....
Sand and gravel.....do....	494,423	132,972	218,974	80,929
Silver.....troy ounces..	.....	.....	111	111
Sodium sulphate from natural sources.....short tons..	(a)	(a)	(a)	(a)
Stone.....do....	123,100	230,556	112,340	239,525
Sulphur.....long tons..	(a)	(a)	.....	.....
Uranium ores.....short tons..	36	2,938	.....	.....
Miscellaneous.....	.....	664,550	.....	365,483
Total value, eliminating duplications.....	.....	83,034,397	.....	51,365,150

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.

PREFATORY NOTE TO THE REPORTS ON GOLD, SILVER, COPPER, LEAD, AND ZINC.

By G. F. Loughlin,
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In the mining industry, gold, silver, copper, lead, and zinc are closely related in both the genesis and the geologic occurrence of their ores, as well as in mining and in metallurgic treatment. Of their ores some contain all five metals, many contain three or four, and few contain only one. Gold and silver, for instance, almost everywhere show close genetic relations, and their ores are usually mined together. Lead and zinc constitute a similar pair. Copper ores almost invariably yield some silver and gold as well as copper, and most lead ores yield notable supplies of silver. Zinc ores in the Western States contribute also to the production of silver. All five metals may occur in commercial quantity in a single mine or, more commonly, in a single mining district. For these reasons each of these metals is treated in Mineral Resources in a general report, and all five metals are grouped together in "mines reports" descriptive of individual or geographically grouped States. These reports are published in 16 separate pamphlets, any of which, until the supply is exhausted, may be obtained by applying to the Director, U. S. Geological Survey, Washington, D. C., mentioning the State or metal concerning which information is desired.

To facilitate advance publication each report is published separately at the earliest date possible. The general reports give figures of the output of the metals in the first marketable form, as obtained from the smelters, refineries, and mints, together with general reviews of the respective industries for the entire country. The figures given in the general reports represent the final official statistics of production for the country and of the States. The general report on gold and silver includes the statistics of recovered precious metals as determined jointly by the Bureau of the Mint and the United States Geological Survey. The "mines reports" give figures of the production (called "mine production") as obtained from the mines, so far as possible in terms of recoverable metal in ores and other material sold or treated during the year; they also supply information in detail relative to the mining industry in the respective States, counties, and mining districts.

Prices of silver, copper, lead, and zinc, 1850–1921.

Year.	Silver.[a]	Copper.[b]	Lead.[c]	Zinc.[d]	Year.	Silver.[a]	Copper.[b]	Lead.[c]	Zinc.[d]
	Fine ounce.	*Pound.*	*Pound.*	*Pound.*		*Fine ounce.*	*Pound.*	*Pound.*	*Pound.*
1850	$1.32	$0.22	$0.05	.....	1886	$0.99	$0.111	$0.046	$0.044
1851	1.34	.166	.05	.....	1887	.98	.138	.045	.046
1852	1.33	.22	.05	.....	1888	.94	.168	.044	.049
1853	1.35	.22	.06	$0.055	1889	.94	.135	.039	.05
1854	1.35	.22	.06	.....	1890	1.05	.156	.045	.055
1855	1.34	.27	.07	.....	1891	.99	.128	.043	.05
1856	1.34	.27	.066	.....	1892	.87	.116	.041	.046
1857	1.35	.25	.06	.....	1893	.78	.108	.037	.04
1858	1.34	.23	.06	.....	1894	.63	.095	.033	.035
1859	1.36	.22	.055	.....	1895	.65	.107	.032	.036
1860	1.35	.23	.056	.....	1896	.68	.108	.03	.039
1861	1.33	.22	.05	.....	1897	.60	.12	.036	.041
1862	1.35	.22	.06	.....	1898	.59	.124	.038	.046
1863	1.345	.34	.06	.....	1899	.60	.171	.045	.058
1864	1.345	.47	.07	.139	1900	.62	.166	.044	.044
1865	1.337	.392	.066	.....	1901	.60	.167	.043	.041
1866	1.339	.342	.07	.....	1902	.53	.122	.041	.048
1867	1.33	.254	.065	.....	1903	.54	.137	.042	.054
1868	1.326	.23	.065	.....	1904	.58	.128	.043	.051
1869	1.325	.242	.06	.....	1905	.61	.156	.047	.059
1870	1.328	.212	.06	.....	1906	.68	.193	.057	.061
1871	1.325	.241	.06	.....	1907	.66	.20	.053	.059
1872	1.322	.356	.064	.....	1908	.53	.132	.042	.047
1873	1.297	.280	.06	.....	1909	.52	.13	.043	.054
1874	1.278	.220	.06	.....	1910	.54	.127	.044	.054
1875	1.24	.227	.058	.07	1911	.53	.125	.045	.057
1876	1.16	.21	.061	.072	1912	.615	.165	.045	.069
1877	1.20	.19	.055	.06	1913	.604	.155	.044	.056
1878	1.15	.166	.036	.049	1914	.553	.133	.039	.051
1879	1.12	.186	.041	.052	1915	.507	.175	.047	.124
1880	1.15	.214	.05	.055	1916	.658	.246	.069	.134
1881	1.13	.182	.048	.052	1917	.824	.273	.086	.102
1882	1.14	.191	.049	.053	1918	.98	.247	.071	.091
1883	1.11	.165	.043	.045	1919	1.12	.186	.053	.073
1884	1.11	.13	.037	.044	1920	1.09	.184	.08	.081
1885	1.07	.108	.040	.043	1921	1.00	.129	.045	.05

[a] Report of Director of the Mint, pp. 212–213, 1914. Equivalent value of fine ounce based on average price and average rate of exchange. For 1916, 1917, and 1919 dealers' buying price, New York. For 1918 average price as stated by the Bureau of the Mint. For 1920 and 1921 New York market price for domestic silver only.

[b] Weed, W. H., Copper Handbook, vol. 11, pp. 1339, 1343, for years 1850–1903. By computation from data for years 1850–1860, p. 1339. Survey computations for electrolytic copper since 1904. For 1916 and later years average price all marketable grades.

[c] New York price, Ingalls, W. R., Lead and zinc in the United States, p. 203, 1908. U. S. Geological Survey since 1904. For 1916, outside spot quotations, New York. For 1917 and later years average price all grades.

[d] New York price, 1875–1904, Ingalls, W. R., Lead and zinc in the United States, p. 342, 1908. St. Louis price, U. S. Geological Survey since 1904. For 1915 and later years average price all grades. Oral communication from C. E. Siebenthal for 1853 and 1864.

CADMIUM.[1]

By C. E. Siebenthal and A. Stoll.

INTRODUCTION.

The production of cadmium in the United States began with a small output in 1906 by the Grasselli Chemical Co. and grew steadily until 1917, when in the midst of the war the maximum was reached, along with the maximum output of zinc. The production of both metals has decreased materially since 1917.

CONDITION OF CADMIUM INDUSTRY.

The production of metallic cadmium in 1921 decreased about one-half and was the smallest since 1913; there was also a large decrease in sales, but, as in 1919 and 1920, the sales exceeded the output, and the stocks were further reduced. The average price fell off nearly 20 cents a pound.

The output of cadmium sulphide was more than double that of 1920, but sales hardly kept pace with the production, and there was a slight decline in price.

It is reported that numerous inquiries were received during the year by metal brokers of New York for cadmium-bearing residues for export.

The udylite process of cadmium electroplating, covered by United States patents 1383174, 1383175, and 1383176, with other patents pending, embodies electroplating with the metal and subsequent heating in an oven for several hours at 150°–200° C., by which the cadmium coating is alloyed with the metal of the article coated. Late in 1921 this process was installed in 18 plants and contracts were made for installations in 9 more plants. This process has been applied to rust-proofing locks, hardware, kitchen-cabinet and refrigerator trimmings, automobile parts and accessories, and such wire products as screen wire, wire ropes, and fence wire.

"The metallurgy of zinc and cadmium," by Dr. H. O. Hofman, recently published, devotes 25 pages to cadmium, supplementing the general treatment of the metal by descriptions of the recovery by fractional distillation in Europe and of chemical and electrochemical methods as practiced by the producers of cadmium in America.

[1] A more complete account of the production, resources, metallurgy, and uses of cadmium was given in Mineral Resources for 1908. Another account describing in some detail the cadmium-bearing by-products produced in the United States and their possibilities as commercial sources of cadmium and giving the results of attempts to substitute cadmium for tin in solders was included in Mineral Resources for 1918. A detailed report is contemplated, to be published as a bulletin of the United States Geological Survey.

PRODUCTION.

There are several cadmium minerals, but none of them occur in quantities large enough to be called ores. The cadmium of commerce is derived from zinc minerals and ores, in almost all of which it occurs in minute quantity, the ratio being about 1 of cadmium to 200 of zinc. Cadmium behaves metallurgically almost the same as zinc and hence constitutes a fraction of 1 per cent of almost all metallic zinc. The sources of cadmium that have been utilized are zinc ores treated by fractional distillation, lead-furnace bag-house "fumes" (the cadmium content of which is derived from the zinc minerals contained in the charge of lead ore), and residues from the purification vats of electrolytic zinc plants and lithopone plants. The production of cadmium, either as the metal or as the sulphide, has been reported by the companies in the following list, which shows also the nature of the metallurgic plant in connection with which the cadmium plant is operated:

Producers of cadmium in the United States in 1921.

Company.	Location of plant.	Associated plant.
American Smelting & Refining Co	Denver, Colo	Lead smelter.
Grasselli Chemical Co	Cleveland, Ohio	Chemical works.
Krebs Pigment & Chemical Co	Newport, Del	Lithopone plant.
Midland Chemical Co	Argo, Ill	Do.
Mineral Refining & Chemical Corporation	Carondelet, Mo	Do.
United States Smelting, Refining & Mining Co	Kennett, Calif	Electrolytic zinc plant.
Do	Midvale, Utah	Lead smelter.

The plants at Kennett, Calif., and Argo, Ill., reported no output in 1921. The lead furnaces at the Globe plant of the American Smelting & Refining Co., at Denver, have been closed for some years, but stocks of cadmiferous residues remain from former operations, and additional residue has been purchased from other plants. Several companies that produce cadmium-bearing residues sell them to the producing companies listed above.

The following table, compiled from reports by each producer of cadmium in the United States and from official reports of the Upper Silesian output, shows that from 1910 until 1918 the production of cadmium in the United States gained rapidly on that of Upper Silesia and at length surpassed it, but in 1918 Upper Silesia reached her maximum output with nearly twice the reduced production of the United States in that year. The production of these two countries has constituted practically the whole cadmium output of the world, though a small quantity is made at electrolytic zinc plants in England.

Metallic cadmium and cadmium sulphide produced in the United States and Upper Silesia, 1906–1921.

Year.	United States.						Upper Silesia.		
	Metallic cadmium.			Cadmium sulphide.			Metallic cadmium.		
	Quantity (pounds).	Value based on sales.	Average price per pound.	Quantity (pounds).	Value based on sales.	Average price per pound.	Quantity (pounds).	Value.	Average price per pound.
1906	300	$300	$1.00	(a)	.....	.....	47,368	$36,083	$0.76
1907	14,000	14,350	1.025	(a)	.....	.....	72,639	60,757	.84
1908	8,000	6,000	.75	(a)	.....	.....	72,741	48,590	.67
1909	5,300	2,783	.525	(a)	.....	.....	81,982	46,777	.57
1910	4,700	2,585	.55	(a)	.....	.....	90,516	39,309	.43
1911	26,152	17,566	.67	2,392	$1,674	$0.70	93,861	53,372	.57
1912	52,508	39,875	.76	8,998	6,400	.71	94,262	63,507	.67
1913	54,198	41,838	.77	17,302	12,136	.70	81,993	63,641	.78
1914	b 91,409	81,205	.89	22,723	20,241	.89	c 86,362	.....	c M. 2.95
1915	91,415	108,443	1.19	10,624	12,057	1.13	c82,177	.....	c 2.90
1916	135,212	210,931	1.56	22,176	27,942	1.26	c 127,341	.....	c 4.81
1917	207,408	305,097	1.47	50,169	70,939	1.41	c 172,284	.....	c 6.73
1918	127,164	188,203	1.48	51,702	70,315	1.36	c 235,542	.....	c 6.32
1919	99,939	121,926	1.22	31,197	37,436	1.20	c 85,395	.....	c 16.51
1920	129,283	151,261	1.17	32,133	37,274	1.16	c 45,971	.....	c 45.27
1921	65,101	63,799	.98	65,446	71,336	1.09	(d)	.....	.....
	1,112,089	1,356,162	.....	314,862	367,750	.....	.....	.....	.....

a No production.
b Exclusive of 4,225 pounds of cadmium in residues sold for export.
c Statistics of production and average selling price for 1914–1919 from Gluckauf, vol. 56, pp. 818–819, for 1920, vol. 57, p. 367, 1921. The value is expressed in marks because the exchange value of the mark is not available for part of the period.
d Figures not available.

IMPORTS.

Cadmium was imported into the United States, before the World War, as metallic stick cadmium and as the pigment, cadmium sulphide. The former is free of duty; the latter is dutiable at 30 per cent ad valorem. The following table, which is taken from the records of the Bureau of Foreign and Domestic Commerce, shows only the imports of metallic cadmium, as the quantity and value of cadmium imported as a pigment are not recorded separately by that bureau. No cadmium was imported in 1916 to 1920.

Cadmium imported and entered for consumption in the United States, 1910–1921.

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1910	4,060	$2,295	1916	.....	.....
1911	5,367	3,870	1917	.....	.....
1912	5,250	3,764	1918	.....	.....
1913	1,656	1,232	1919	.....	.....
1914	441	368	1920	.....	.....
1915	269	284	1921	101	$216

EXPORTS.

Statistics of the exports of cadmium are not separately kept by the Bureau of Foreign and Domestic Commerce, and hence are not regularly available, but it is known that a considerable quantity of domes-

tic cadmium was exported during the World War. Special canvasses show that about 40,000 pounds of cadmium was exported in 1918, of which the larger part went to France. Such figures of exports as are available are given in the chapter on cadmium in Mineral Resources for 1919.

PRICES AND VALUE.

The price of metallic cadmium was quoted at $1.40 to $1.50 a pound at the beginning of 1921 and showed no change until the middle of March, when it was reduced to $1.20 a pound. This price prevailed until the first of December, when a further reduction gave a quotation of $1.10 to $1.20 a pound, and this price continued till the end of the year. Cadmium sales are so irregular, however, that the quotation is nominal much of the time, and sales in large lots are made at figures considerably less than the quoted price. The average price of metallic cadmium for 1921, based on sales reported by producers, was $0.98 a pound, as compared with $1.17 in 1920. The average price of cadmium sulphide in 1921 was $1.09 a pound, compared with $1.16 in 1920.

The value of the metallic cadmium produced in the United States in 1921, at the average price stated above, was $63,799, as compared with $151,261 in 1920. The value of the cadmium sulphide produced in 1921 amounted to $71,336, as compared with $37,274 in 1920.

COMMERCIAL STANDARDS OF QUALITY.

The European commercial standard of purity for metallic cadmium is 99.5 per cent cadmium, and this standard is the basis of sales in this country, although the metal actually marketed generally runs higher in cadmium content, some of it reaching 99.9 per cent, and guaranties of purity above the commercial standard can be obtained if desired.

Similar commercial standards for cadmium sulphide do not exist, but the pigment as sold ranges from 98 to 99.9 per cent pure. Some sales are made on the basis of a sample submitted by the purchaser, which is matched in quality by the seller.

The following analyses of metallic cadmium are given by Hofman:[2]

Analyses of commercial cadmium.

	1	2	3
Cadmium	99.839	99.75	99.47
Copper	.005	None.	.05
Lead	.040	.03	.32
Arsenic	.009	None.	Undet.
Zinc	.100	.18	.01
Iron	.021	None.	.005
Sulphur	.005	Undet.	Undet.
	100.019	99.96	99.855

1. Sample from American Smelting & Refining Co.
2. Sample from United States Smelting, Refining & Mining Co.
3. Sample from Grasselli Chemical Co.

[2] Hofman, H. O., Metallurgy of zinc and cadmium, p. 311, 1922.

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GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN STATES.[1]

(MINES REPORT.)

By J. P. Dunlop.

MINE PRODUCTION.

The total value of the gold, silver, copper, lead, and zinc mined and sold in the Eastern States in 1921 showed a decrease of about 47.5 per cent from the corresponding value in 1920. Of the total value gold represented $9,934; silver, $98,792; copper, $1,986,290; and zinc, $10,521,030. The decrease was caused mainly by the decreased output and price of copper and zinc.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1920–1921.

Year.	Ore sold or treated.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	2,418,500	$8,515	112,183	17,138,675	4,003,078	204,484,000	$24,014,717
1921	1,502,277	9,934	98,792	15,397,596	.....	135,422,000	12,616,046
Increase or decrease, 1921	−916,223	+1,419	−13,391	−1,741,079	−4,003,078	−69,062,000	−11,398,671

GOLD.

Of the mine output of gold in 1921 placers yielded $1,591, siliceous gold ores $3,423, and copper ores $4,920. The deep and placer gold mines, which in former years produced nearly all the gold in the Eastern States, supplied only 50 per cent in 1921, and the minor character of the operations at such mines is best shown by the fact that their total output of $5,014 was derived from 18 properties. The small quantity of siliceous ore mined was treated in small mills by amalgamation, and none of the large mills or cyanide plants were operated. Most of the ore is of low grade, and the continued high cost of supplies and the scarcity and inefficiency of available labor prevented profitable mining. About half of all the gold was obtained in refining copper bullion, the only uninterrupted source of gold in these States in the last four years.

[1] U. S. Geol. Survey Mineral Resources, 1908, pp. 645–681, contains references to the geology of the various States and gives the Geological Survey, State Survey, and other publications relating to the geology and mines in all the eastern States; and U. S. Geol. Survey Mineral Resources, 1914, pp. 139–163, contains a historical review of the production of gold in the southern Appalachian States and a list of Survey publications on gold, silver, copper, lead, and zinc in the Eastern States.

Lower wages and a decreased demand for labor in other industries resulted in slightly increased operations at small placers and deep gold mines. In 1922 there will be a considerable increase in the quantity of gold produced from the working of scattered diggings and purchased by banks and merchants, but it is improbable that there will be any marked increase in the output of the large mines.

SILVER.

More than 99 per cent of the output of silver in 1921 was derived from copper ores, and all the remainder except 7 ounces came from siliceous ores.

Mine production of gold and silver in the Eastern States in 1921, by States.

State.	Gold.		Silver.		Increase or decrease in value compared with 1920.	
	Fine ounces.	Value.	Fine ounces.	Value.	Gold.	Silver.
Alabama					−$296	−$10
Georgia	49.44	$1,022	4	$4	+290	−207
Massachusetts and Pennsylvania					−178	−1,362
North Carolina and South Carolina	156.20	3,229	18	18	+1,750	+6
Tennessee	238.00	4,920	98,762	98,762	−910	−21,922
Virginia	36.91	763	8	8	+763	+8
	480.55	9,934	98,792	98,792	+1,419	−23,487
Total, 1920	411.91	8,515	112,183	122,279		

Mine production of gold and silver in the Eastern States in 1921, by sources, in fine ounces.

State.	Gold.				Silver.			
	Placers.	Dry or siliceous ores.	Copper ores.	Lead and copper-lead ores.	Placers.	Dry or siliceous ores.	Copper ores.	Lead and copper-lead ores.
Georgia	34.40	15.04			3	1		
North Carolina	40.15	113.63			4	14		
South Carolina	2.42							
Tennessee			238.00				98,762	
Virginia		36.91				8		
	76.97	165.58	238.00		7	23	98,762	
Total, 1920	57.18	36.58	282.02	36.13	5	16	110,809	1,353

COPPER.

The mine production of copper in the Eastern States in 1921 was valued at $1,986,290, a decrease of $1,167,226. Of the total output 15,084,294 pounds was derived from Tennessee copper ores and 313,302 pounds from Pennsylvania pyritiferous magnetite ore.

The total quantity of ore treated to produce this copper was 736,357 short tons. Exclusive of the magnetite ore, which was mined for its iron content and contained very little copper, the average yield of copper was approximately 1.34 per cent, or 26.7 pounds to the ton, and this copper ore also yielded $0.19 in gold and silver to the ton. Copper ores directly smelted amounted to 461,940 tons, from which about 12,283,000 pounds of copper was recovered.

Copper and pyritiferous magnetite ores concentrated amounted to 274,417 tons, which yielded 13,557 tons of concentrates containing 3,114,502 pounds of copper and small quantities of gold and silver.

LEAD.

No shipments of lead were reported by mines in the Eastern States in 1921. Some lead ore was mined in Virginia, but the concentrates were not sold in 1921. In 1920 Tennessee produced 3,957,000 pounds, Massachusetts, 27,578 pounds, Pennsylvania, 14,700 pounds, and Georgia, 3,800 pounds.

ZINC.

The recoverable production of zinc in the Eastern States in 1921 was valued at $10,521,030, a decrease of $9,889,131. New Jersey produced 112,894,000 pounds, Tennessee 19,384,000 pounds, and New York 3,144,000 pounds. Zinc ore mined and treated amounted to 764,685 tons, of which 400,080 tons was from New Jersey and 39,940 tons from New York. Nearly all the zinc ore from Tennessee and New York was sent to concentrating plants, and 351,726 tons of the zinc ore from New Jersey was concentrated and the remainder shipped as crude ore.

REVIEW BY STATES.

ALABAMA.

The value of the gold produced by mines in Alabama during the period 1830 to 1920 was $766,632.[2]

No production of gold or silver was reported from mines in Alabama in 1921. Old properties, such as the Gold Log and Gold Ridge and other mines in Cherokee, Randolph, and Tallapoosa counties, were idle. Some development work was done at the Jemison prospect, in Chilton County. In 1920 the production of gold amounted to $296 and that of silver to 9 ounces.

GEORGIA.

The value of the gold produced in Georgia during the period 1830 to 1920 was $17,825,268,[2] or more than one-third of the estimated total production of the southern Appalachian States.

In 1921 mines in Georgia produced 49.44 ounces of gold, valued at $1,022, and 4 ounces of silver, an increase of $290 in the value of gold and a decrease of 190 ounces in the quantity of silver, as compared with 1920. Small quantities of gold and silver were reported from prospect work and a little siliceous ore was milled. Most of the gold was derived by panning or sluicing gravels, and operations were spasmodic and small, though more extensive than in 1920.

Placer production was reported from Cherokee, Douglas, Lumpkin, Rabun, and Wilkes counties. The Sixes placer, near Canton, and the old Creighton placer, at Ball Grand, both in Cherokee County, were small producers. The old mines at Dahlonega and Auraria yielded very little gold, though some development work was done

[2] Director of the Mint Ann. Rept., 1921, p. 49

at the Barton. It is stated that the Turkey Hill property will be worked after March, 1922. The largest output of gold in Georgia in 1921 was that of Haughey & Haughey from a property near Rayle, in Wilkes County.

MAINE, MARYLAND, NEW HAMPSHIRE, AND VERMONT.

Apparently none of the gold or copper mines in Maine, Maryland, New Hampshire, or Vermont were operated in 1921.

MASSACHUSETTS.

At the old Chipman mine, at Highfield, Essex County, Mass., which was reopened in 1919 by the Merrimac Development Co., prospecting was continued until February, 1921, when the mine was closed. A brief but comprehensive description of the workings of the mine and the character of the ore, by G. F. Loughlin, is contained in the chapter on gold, silver, copper, lead, and zinc in the Eastern States in 1919, copies of which may be obtained upon application to the Director, United States Geological Survey, Washington, D. C.

NEW JERSEY.

The production of zinc ore in New Jersey in 1921 was, as usual, confined to the Mine Hill and Sterling mines, at Franklin Furnace, Sussex County, and amounted to 400,080 tons, which contained 112,894,000 pounds of recoverable zinc. The crude ore produced in 1920 amounted to 535,207 tons and contained 154,742,000 pounds of recoverable zinc. Only a part of the zinc ore mined at Franklin Furnace is used directly for the manufacture of zinc. The greater part of this zinc is normally converted into oxide at works in Pennsylvania.

NEW YORK.

The quantity of zinc ore from New York treated in 1921 was 39,940 tons. Some of the concentrates were stored at the mines, and those shipped contained 3,144,000 pounds of zinc. The Northern Ore Co., operating the Brown mine, near Edwards, St. Lawrence County, treated most of this ore. A vertical shaft 900 feet deep and an 800-foot inclined shaft were operated for about six months in 1921. The mine has been kept unwatered so that operations may be resumed when the price of zinc increases. None of the pyrite concentrates were sold in 1921. Ore extracted from levels at 840 to 860 feet is dropped to the 900-foot level, hoisted, and trammed by means of a gasoline motor to the mill. The mill, which is constructed of steel and tile, is equipped with crusher, rolls, Dorr thickener, and 17 tables. The table concentrates, which assay about 32 to 33 per cent of zinc, are treated by 13 Electric Ore Separating Co. machines, which, by removing much of the pyrite, raise the zinc content to 47 to 48 per cent. These electric machines treat wet concentrates, and to avoid the clogging of the riffles in the separator and insure their proper operation it is necessary to remove by means of a powerful magnet all the small particles of metallic iron abraded from the rolls and crusher. The average zinc assay of the crude ore treated ranges from 15 to 20 per cent, and the finished concentrates average about

48 per cent. The developed bodies of ore are large, and it is probable that others will be mined on the large tract owned by the Northern Ore Co.

The Hyatt Ore Corporation's mine at Hyatt, 3 miles west of Edwards, has a 320-foot inclined shaft on ore very similar to that of the Northern Ore Co. The 100-ton plant erected in 1920 contains crusher, rolls, jigs, and tables and was operated most of the year.

NORTH CAROLINA.

The value of the gold produced in North Carolina during the period 1799 to 1920 was $23,629,580.[3] In 1915 the recovery of gold was $172,001, but since then increased costs of mining and milling the low-grade ores and gravels have made operation so unprofitable that mining has been nearly discontinued. Part of the small output in 1921 came from placer mines, and most of the gold from deep mines was derived from the Pee Dee mine, near Asheboro, Randolph County. None of the deep mines in Moore, Catawba, Davidson, and Rowan counties had any output. A little prospecting was done at the Rich Cog mine, in Montgomery County.

The Sylvania Mining Co. did a little development work near Rutherfordton but treated no ore. The erection of a 30-stamp mill and concentrating equipment near Franklinville, Randolph County, was completed by A. J. Overton. Large bodies of low-grade ore are reported to have been opened by means of open cuts, and some ore was milled in 1921, but milling was suspended during the installation of a cyanide plant to treat the ore and the concentrates now stored.

At the Pee Dee mine, owned by P. D. Elliott, 7 mines from Asheboro, Randolph County, 10 men were employed in development work and a 10-stamp mill was erected. The mill was operated only a few days, but it was the largest producer of gold from siliceous ores in the Appalachian States in 1921. The shafts at the mine are about 100 feet deep, and 550 feet of drifts were run in 1921.

The placer gold produced in 1921 came from the Brindletown mines, in Burke County; the Third Creek mine, near Cleveland, Rowan County; the Biggerstaff mine, near Golden, Rutherford County; and scattered pickups and pannings in Union, Montgomery, and Cabarrus counties.

PENNSYLVANIA.

The Cornwall iron mines, in Lebanon County, Pa., operated for five months in 1921 by the Bethlehem Steel Co., produced several thousand tons of a low-grade copper concentrate from pyritiferous magnetite ore. The concentrate, which was shipped to smelters, contained about 32 per cent of sulphur and 3.36 per cent of copper.

SOUTH CAROLINA.

Mines in South Carolina produced $5,181,842 in gold during the period 1829 to 1920.[3]

The entire output of $50 in gold in 1921, consisted of nuggets picked up on creeks and gullies in Spartanburg and Abbeville counties.

[3] Director of the Mint Ann. Rept., 1921, p. 49.

No copper ore was mined or shipped from the mines near Smyrna, in York County, but the Darwin and Wolf Creek mines were acquired by the Darcnella Mining Co. The hillside soil will be sluiced, and if possible the low-grade quartz ore will be sold as a flux. Some work was also being done on a prospect near Smyrna, by B. S. Bonebrake.

TENNESSEE.

The gold produced at mines in Tennessee during the period 1831 to 1920 amounted to $264,502.[4] A large part of the output prior to 1879 was derived from placer mines, but the output since 1906 has been recovered entirely from copper ore mined in Polk County.

Mine production of gold, silver, copper, lead, and zinc in Tennessee, 1905–1921.

Year.	Ore sold or treated.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1905–1914	6,401,574	$57,630	808,443	182,379,746	.....	42,662,808	$30,483,771
1915	1,149,364	6,862	100,543	18,046,010	1,660	32,922,902	7,298,406
1916	1,184,821	5,739	94,701	14,679,794	32,960	52,855,480	10,764,189
1917	1,533,983	5,326	99,053	16,033,749	5,061,937	56,995,107	10,712,985
1918	1,159,971	4,866	93,620	14,799,680	3,410,400	42,141,311	7,831,005
1919	1,227,534	5,662	98,288	15,623,589	4,376,000	46,494,000	6,647,723
1920	1,120,995	5,830	110,719	16,727,803	3,957,000	38,434,000	6,634,144
1921	889,122	4,920	98,762	15,084,294	.....	19,384,000	3,018,756
	14,667,364	96,835	1,504,129	293,374,665	16,839,957	331,889,608	83,390,979
Decrease, 1921	231,873	910	11,957	1,643,509	3,957,000	19,050,000	3,615,388

Polk County.—The entire output of copper, gold, and silver in Tennessee came from the two large copper mines in the Ducktown district, and the production of all three metals was less in 1921 than in 1920. The Tennessee Copper Co. operated its 2,000-ton smelter, converter, and sulphuric acid plant on crude sulphide ores from the Burra Burra and London mines and the Copper Pyrites Corporation mine at McHarg, held under lease. The pig copper was shipped to the Baltimore Copper Smelting & Refining Co. for refining.

The Ducktown Sulphur, Copper & Iron Co. operated its two 600-ton blast furnaces and 20-foot converter on self-fluxing sulphide ore from the Mary and East Tennessee mines, at Isabella. The Mary and Isabella (idle in 1921) mines are opened by 1,200-foot vertical shafts, and the East Tennessee mine by a 700-foot shaft.

Most of the zinc produced was obtained from the Embree mine, in Washington County, and the Mascot mine, in Jefferson County, as the mines of the Union Zinc Co. in Union County, of the Tennessee Zinc Co. in Claiborne County, and of the Grasselli Zinc Co. in Jefferson County were idle.

The Embree Iron Co. operated the Embree mine, which produces zinc carbonate and lead carbonate ores. Part of the zinc ore is shipped directly from the mines, and part is concentrated by means of log washers and tables. The dried crude zinc ore and concentrates contained 41.76 per cent of zinc. Some galena ore was concentrated by means of jigs and tables into a product averaging about 62 per cent of lead, but no lead concentrates were sold in 1921.

[4] Director of the Mint Ann Rept., 1921, p. 49.

The American Zinc Co. of Tennessee continued its steady operation of the Mascot mine. The sulphide ore was hoisted from the mine through the 800-foot shaft. The concentrating plant is equipped with jigs, tables, and oil flotation and has a capacity of 2,400 tons in 24 hours.

VIRGINIA.

The mines of the Bertha Mineral Co., at Austinville, and the Helen Mineral Co., at Ivanhoe, in Wythe County, Va., were idle in 1920 and 1921, and no recoveries of gold and silver were reported from the smelting of pyritic ores. The value of gold produced from mines in Virginia during the period 1828 to 1920 was $3,296,569,[5] of which less than $14,000 has been recovered during the last 11 years. The deep and placer gold mines in Albemarle, Floyd, Fauquier, Goochland, and Fluvanna counties yielded about half of the total in that period, the remainder of the gold was derived from cinders of pyritic ores or copper ores shipped to smelting plants.

For the first time in several years siliceous quartz ore was mined in Virginia, and $763 in gold and 8 ounces of silver were recovered from mines and prospects in Louisa and Orange counties. Prospecting was done on the Partridge property, near Broad Run, Orange County, and some ore containing gold and silver was taken from open cuts. A small experimental amalgamation plant was operated on ore taken from open cuts on the R. E. Dolan property, near Mineral, Louisa County, and a good recovery of bullion was made.

[5] Director of the Mint Ann. Rept., 1921, p. 49.

CHROMITE.

By Edward Sampson.[1]

The quantity of chromite marketed in 1921 was the smallest since 1913. The total quantity of domestic ore sold was 282 long tons, equivalent to 245 long tons of 50 per cent ore. Although this quantity is trifling as compared with that sold during the World War, as shown in the table on page 16, it is close to the average annual production from 1900 to 1913, inclusive, which was 232 tons.

Crude chromite mined and shipped from mines in the United States in 1921, by States.

State.	Ore containing 45 per cent or more of chromic oxide.			Ore containing 35 to 45 per cent of chromic oxide.			Total value.
	Mined (long tons).	Shipped (long tons).	Average value.	Mined (long tons).	Shipped (long tons).	Average value.	
California	91	68	$17.09	.....	55	$2.25	$1,286
Oregon	.....	.....	.....	159	159	10.15	1,614
	91	68	17.09	159	214	8.12	2,900

All the producers have permitted the publication of figures showing individual production, thereby making an analysis of the statistics possible. If the one exceptionally low price in the above table is omitted the average price at the mine was $12.23, or about 19 per cent less than the average price from 1900 to 1913, which was $15.11.

PRODUCERS.

So far as known to the Geological Survey, chromite was mined at only three places in 1921, and only two of the producers reported sales. One sale is recorded from stock previously mined.

In California D. J. Sullivan mined and shipped ore from Gorge station, in Placer County; J. A. Ferbrache mined a small quantity of ore 7 miles northwest of Gilroy, in Santa Clara County; and the Coggins Bros. Co. shipped a carload of ore from stock from its mine on Little Castle Creek, near Dunsmuir, in Siskiyou County. After shipment to the East Mr. Arthur L. Coggins states, his firm was informed that the ore was 0.1 per cent high in silica, and in consequence of this excess over the percentage specified in the contract the company received only $2 a ton more than the freight rate.

F. W. Peet mined and shipped ore from Prairie City, Grant County, Oreg.

[1] The figures showing domestic production have been collected and compiled by Miss H. M. Meyer, of the U. S. Geological Survey.

IMPORTS.

Crude chromite imported into the United States, 1913 and 1917–1921, in long tons.[a]

Country.	1913	1917	1918	1919	1920		1921		
					Quantity.	Average value.	Quantity.	Value.	Average value.
Australia	.....	.....	15,976	13,161	2,778	$33.95	.....	.....	.....
Belgium	.....	.....	.....	.....	239	35.51	.....	.....	.....
Brazil	.....	.....	17,854	4,800	3,451	21.36	.....	.....	.....
British South Africa	.....	4,750	521	29	39,400	6.81	23,318	$79,490	$3.41
Canada	.....	19,012	20,949	8,941	8,491	20.00	7,554	45,011	5.96
Cuba	.....	17	8,821	14,461	710	28.73	600	18,000	30.00
England	.....	5	4	.....	3,799	30.46	.....	.....	.....
French Oceania [b]	21,850	10,300	25,761	7,125	[b] 50,314	8.99	35,108	198,027	5.64
Germany	.....	.....	.....	.....	1	83.00	.....	.....	.....
Greece	4,600	.....	.....	.....	5,302	27.25	8,104	163,880	20.22
Guatemala	.....	179	1,193	1,659	1,122	61.46	401	20,883	52.08
India	.....	.....	.....	.....	4,500	16.67	928	11,166	12.03
Japan	79	.....	.....	.....	.....	.....	.....	.....	.....
New Zealand	.....	.....	.....	693	.....	.....	.....	.....	.....
Other British Oceania	.....	.....	1,063	.....	.....	.....	.....	.....	.....
Peru [b]	.....	.....	.....	.....	[b] 6,368	25.00	.....	86	.....
Portuguese Africa	30,001	37,800	8,000	4,000	11,000	3.97	.....	20	.....
Spain	.....	.....	.....	3,035	40	31.25	.....	.....	.....
Turkey in Asia	8,650	.....	.....	3,500	12,760	17.71	5,822	117,940	20.26
Turkey in Europe	.....	.....	.....	.....	.....	.....	1	99	99.00
	65,180	72,063	100,142	61,404	150,275	12.79	81,836	654,602	8.00

[a] Statistics compiled by J. A. Dorsey, of the Geological Survey, from records of Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce.

[b] The Bureau of Foreign and Domestic Commerce reports that the ore listed under Peru should be credited to French Oceania.

The imports of chromium compounds are small as compared with the consumption.

Chromium compounds imported for consumption in the United States, 1917–1921.[a]

Year.	Chromic acid.			Chromate and bichromate of potash.			Chromate and bichromate of soda.			Chrome or chromium and ferrochromium.		
	Pounds.	Value.	Average value.	Pounds.	Value.	Average value.	Pounds.	Value.	Average value.	Long tons.	Value.	Average value.
1917	.....	.....	.....	2,402	$962	$0.40	22,025	$4,075	$0.19	.....	.....	.....
1918	9,512	$1,857	$0.19	20	8	.40	5,102	1,184	23	.....	.....	.....
1919	.....	.....	.....	15,450	4,271	.28	.....	.....	.....	414	$100,404	$243
1920	1,100	90	.08	4,414	2,690	.61	.....	.....	.....	1,751	428,619	245
1921	1,969	674	.34	73,011	6,772	.09	64,236	5,308	.08	452	106,669	236

[a] From records of the Bureau of Foreign and Domestic Commerce.

CONSUMPTION.

Domestic sales, imports, and apparent consumption of chromite in the United States, 1913 and 1917–1921.

Year.	Domestic sales.			Imports.			Apparent available supply.		
	Long tons.	Value.	Average value.	Long tons.	Value.	Average value.	Long tons.	Value.	Average value.
1913	255	$2,854	$11.19	65,180	$622,821	$9.56	65,435	$625,675	$9.56
1917	43,725	1,049,400	24.00	72,063	1,110,659	15.41	115,788	2,160,059	18.66
1918	82,430	3,955,567	47.99	100,142	2,892,825	28.89	182,572	6,848,392	37.51
1919	5,079	129,302	25.46	61,404	1,381,497	22.50	66,483	1,510,799	22.72
1920	2,502	44,857	17.93	150,275	1,921,824	12.79	152,777	1,966,681	12.87
1921	282	2,900	10.28	81,836	654,602	8.00	82,118	657,502	8.01

In spite of the very large imports in 1920 and consequent large reserve supply accumulated by consumers, the imports in 1921 were remarkably high, the result doubtless of the low prices, the average price, $8, being even less than the average of $9.56 in 1913. It is thought that a large reserve supply is available, perhaps enough for more than a year's consumption.

The Geological Survey does not collect figures that would show the final disposition of the chromite. An estimate of the disposition made in 1918 by the War Industries Board, after a canvass of the consumers, indicated that out of 130,000 tons of 50 per cent ore ferrochrome would require 52 per cent, chemicals 31 per cent, and refractories 17 per cent. These figures can not be taken to apply closely to a normal year, but they give an idea of the relative order of magnitude, and with them in mind it is interesting to note the record of sales of ferrochrome in 1919 and 1920, the only years for which figures are yet available.[2] These sales, in part estimated, were as follows: 1919, 15,763 long tons; 1920, 16,606 long tons. It appears that the quantity of 50 per cent chromite required to yield this amount of ferrochrome, on the arbitrary assumption of no loss of chromium in slag, would be 31,700 long tons for 1919 and 33,400 long tons for 1920.

WORLD'S PRODUCTION.[3]

Crude chromite produced by different countries, 1917–1920, in metric tons.

Country.	1917	1918	1919	1920
Austria-Hungary [a]	12,600	(b)	(b)	
Australia [c]	1,142	611	254	(b)
Brazil [d]		18,141	4,877	3,506
Canada [e]	33,317	19,952	8,678	9,993
Cuba [d]	17	8,963	14,693	721
Great Britain [f]	303	142	152	1,118
Greece [g]	9,600	2,640	4,070	(b)
Guatemala [d]	182	1,212	1,686	1,140
India [h]	27,495	58,697	37,024	(b)
Japan [i]	8,941	6,247	6,012	(b)
New Caledonia [j]	41,892	55,177	23,548	60,000
Norway [k]	3,975	2,783	(b)	(b)
Rhodesia [l]	66,190	28,382	32,007	54,674
Russia [m]	(b)			
Turkey (Asia Minor) [n]	(b)	(b)	3,500	25,000
United States	44,427	83,753	5,161	2,542
	250,081	286,700	141,662	[m] 190,000

[a] 1917: Min. Jour. London, Dec. 18, 1920 (production for Hungary); 1920, estimate.
[b] Figures not yet available.
[c] New South Wales Dept. Mines Ann. Repts. Queensland Undersecretary for Mines Ann. Repts.
[d] Imports into United States, Bur. Foreign and Domestic Commerce.
[e] Canada Dept. Mines, Mines Branch, Ann. Repts.
[f] Mines and Quarries, General Reports, pt. 3.
[g] 1917: Tableaux statistiques du mouvement minier de la Grèce. 1918–19: Information from United States consulate general, Athens, Greece, Aug. 31, 1920. 1920: Information furnished by Direction du Service des Mines, Athens, Greece.
[h] 1917–1918: India Geol. Survey Records, 1919; Preliminary statement by director India Geol. Survey.
[i] 1917: Résumé statistique de l'empire du Japon. 1918–19: Mining Industry, Japan Dept. Commerce, Bur. Mines.
[j] 1917: Bulletin de l'Agence des colonies. 1918: Statisque de l'industrie minérale en France et en Algérie. 1919: Exports. 1920: Estimate.
[k] Norges Bergverksdrift.
[l] Report of Secretary for Mines, Rhodesia.
[m] Estimate.
[n] Estimates. 1919: This report. 1920: This report, on basis, largely, of information furnished by E. J. Lavino & Co., importers.

[2] Burchard, E. F., and Davis, H. W., Iron ore, pig iron, and steel: U. S. Geol. Survey Mineral Resources, 1920, pt. 1, p. 393, 1922.
[3] For more complete data see pp. 513–564.

MAGNESIUM.

By G. F. Loughlin.

PRODUCTION AND PRICES.

Only one company, the American Magnesium Corporation, of Niagara Falls, N. Y., reported a production of metallic magnesium in 1921 to the United States Geological Survey. The quantity produced (10,044 pounds) was far less than in previous years and was, as in 1920, obtained incidentally in experimental operation of furnaces. This magnesium was made from California magnesite. The quantity of stick or ingot and powder sold or used (manufactured largely from stocks on hand) was more than four times as great as the quantity of new magnesium produced. A few thousand pounds of magnesium alloys (containing more than 90 per cent magnesium) and much smaller quantities of castings and ribbon were also sold or used. Stocks on hand at the end of the year also exceeded the quantity of new metal produced. One other company may also have worked up stock held over from 1920 but has failed to report on its activities.

The average price for high-grade domestic magnesium sold as sticks in 1921 was about $1.60 a pound, the same as in 1920; but one lot of impure metal was sold at a specially low rate, reducing the general average price to $1.30. The average price of the powder was about $2.25 a pound, a decrease of 50 cents compared with 1920.

IMPORTS.

In contrast to domestic production, imports continued to increase in 1921, as shown in the following table:

Magnesium imported into the United States, 1918–1921.[a]

Year.	Pounds.	Value.	Average value.
1918, July to December	11,899	$16,259	$1.37
1919	13,239	13,583	1.02
1920	29,275	25,055	.85
1921	39,913	30,592	.77

[a] Compiled from records of the Bureau of Foreign and Domestic Commerce, Department of Commerce, by J. A. Dorsey, of the United States Geological Survey.

Imports were heavy in the later part of the year, and the low prices quoted, particularly from Germany, would have precluded competition by domestic producers even if general industrial conditions had been better. It is stated that the manufacturers of magnesium in England and France have been similarly affected, as

Germany controls within its borders the necessary raw materials and with its depreciated currency can undersell in any market, in spite of its export duty and the import duties into other countries.

The tariff bill reported by the Senate Finance Committee in April, 1922, calls for a duty of 50 cents a pound on metallic magnesium and 50 cents a pound and 20 per cent ad valorem on magnesium alloys.

OUTLOOK.

Notwithstanding the present discouraging conditions, real progress was made during the year, particularly in improving the purity of the metal. The American Magnesium Corporation claims ability to produce commercial magnesium 99.98 per cent pure. Magnesium is said to resemble zinc in that for structural purposes or machine parts it must be practically free from even minute quantities of certain impurities, particularly alkalies and chlorine, which cause local granular corrosion and have given magnesium the reputation of being unstable. A reported criticism of imported magnesium is that it is impure.

In commenting on developments in 1921, the president of the American Magnesium Corporation[2] states:

> Details in the process of producing metallic magnesium have been practically solved, and the bulk of the work accomplished during the year has been in the field of special problems incident to the commercializing of partly manufactured forms, such as castings, sheet, rod, tubing, wire, and forgings. Each of these forms requires a special technique, as the working of magnesium, though not inherently more difficult than that of other metals, requires wide and detailed research.
>
> Preliminary work toward the necessary introductory selling effort has already been started in the aviation field, in textile machinery, instruments of precision, drafting tools, the reciprocating parts of automotive engines, typewriters, and sewing machines. In each application of magnesium a special study of the requirements must be made, and only after repeated trials can the qualities of magnesium be properly developed to suit each individual condition. Experimental work in alloys is well along, and results that are in general comparable to the average results obtained from aluminum alloys are already indicated. By alloys is to be understood metals containing more than 85 per cent of magnesium.
>
> There is not sufficient demand for metallic magnesium in this country, if its use is confined to deoxidation, to minor alloys, and to pyrotechnics, to warrant any considerable investment in the manufacture of the metal. Only by the development of its use as a structural material in such ways as those mentioned above can the industry succeed. The characteristics of the metal make it so essential that the demand for it is certain to increase if sufficient time and money are available, with a reasonable freedom from foreign competition.

[2] Written communication.

ZINC.[1]

By C. E. Siebenthal and A. Stoll.

SUMMARY.

Zinc produced and consumed in the United States, 1920–21, in short tons.

	1920	1921
Production of primary zinc: [a]		
From domestic ore	450,045	198,232
From foreign ore	13,332	2,268
	463,377	200,500
Production of secondary zinc: [a]		
Redistilled	21,371	17,573
Remelted	21,479	16,260
	506,227	234,333
Apparent consumption of primary zinc	323,043	205,600

[a] "Primary zinc," which is produced directly from ore, is here distinguished from "secondary zinc," which is obtained by refining zinc ashes, skimmings, drosses, and old metals. The statistics of secondary zinc are given on page 24. Wherever in this report the word "zinc" is used without qualification it means primary zinc.

Owing to necessary economies in Government printing it has been deemed advisable to omit the notes which have heretofore been published explanatory of the tables in these reports. The reader will find the full notes in the chapter on zinc in Mineral Resources for 1918. For the same reason the period covered by the tables has generally been limited to the years 1917–1921, and some tables have been omitted.

PRODUCTION.

PRIMARY ZINC.

Primary zinc [a] produced in the United States, 1917–1921, in short tons.

Apportioned according to source of ore.

	1917	1918	1919	1920	1921
Total domestic	584,597	492,405	452,272	450,045	198,232
Foreign:					
Canada	6,787	8,700	4,007	1,583	521
Mexico	40,360	14,043	8,083	8,978	1,614
South America		886	751	536	
Europe	11,689	113			
Africa					
Asia					
Australia	26,140	1,780	630	2,235	133
Total foreign	84,976	25,522	13,471	13,332	2,268
Total primary	669,573	517,927	465,743	463,377	200,500

[a] Primary zinc is made directly from ore; secondary zinc is recovered from drosses, galvanizers' ashes old metal, and like sources.

[1] Chapters on zinc that were more than ordinarily detailed were issued in Mineral Resources for 1908, dealing largely with metallurgy; for 1915, dealing with the zinc deposits of the United States and foreign countries; and for 1918, dealing with the zinc industry in relation to the World War.

Primary zinc produced in the United States, 1917–1921, in short tons—Continued.

Apportioned according to locality at which reduced.

	1917	1918	1919	1920	1921
Arkansas	25,660	26,753	31,437	31,481	15,278
Illinois	172,489	141,844	118,458	109,056	48,865
Kansas	76,048	29,149	43,942	41,044	16,573
Oklahoma	204,394	139,066	121,988	110,500	41,244
Pennsylvania	86,995	77,342	67,521	74,234	36,378
Other States	103,987	103,773	82,397	97,062	42,162
	669,573	517,927	465,743	463,377	200,500

DISTILLED AND ELECTROLYTIC ZINC.

Selected secondary zinc materials, such as zinc ashes and scrap, carefully redistilled, yield zinc of all grades, which enters the market for practically all purposes. Considerable secondary material is mixed with ore and used by some regular ore smelters. The quantity of metal so derived can be calculated by the smelters and thus eliminated from the output of primary zinc, but it is practically impossible to segregate the redistilled secondary zinc by grades or in smelter stocks. Hence the smelter stocks as given contain some secondary zinc, and the statistics of production of zinc by grades as given in the table below likewise include secondary zinc. The quantity of secondary zinc included in the graded zinc is given in the first part of the table, which gives the source of the graded zinc by the methods of reduction.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1917–1921, in short tons.

Apportioned according to method of reduction.

	1917	1918	1919	1920	1921
Electrolytic	[a] 25,209	[a] 38,916	27,056	51,626	11,559
Distilled primary	644,364	479,011	438,687	411,751	188,941
Redistilled secondary zinc [b]	16,835	9,918	19,748	21,371	17,573
	686,408	527,845	485,491	484,748	218,073

[a] Prime western zinc refined by electrolysis in addition: In 1917, 1,701 tons; in 1918, 753 tons
[b] For total production of secondary zinc see p. 24.

Apportioned according to grade.

Grade A (high grade)	97,707	129,344	45,377	80,713	24,084
Grade B (intermediate)	69,189	68,987	39,173	33,893	4,996
Grade C (select and brass special)	148,749	98,584	140,917	59,811	47,814
Grade D (prime western)	370,763	230,930	260,024	310,331	141,179
	686,408	527,845	485,491	484,748	218,073

ROLLED ZINC.

The table below includes the exports as shown by the records of the Bureau of Foreign and Domestic Commerce. If the figures showing the exports are deducted from those showing the production plus imports, the result will approximate the quantity available for domestic consumption.

Zinc rolled in the United States, 1920 and 1921.

		1920	1921
Sheet zinc not over one-tenth inch thick:			
Quantity	pounds	56,812,989	28,580,904
Value		$6,625,660	$2,844,406
Average price per pound		$0.117	$0.100
Boiler plate and sheets over one-tenth inch thick:			
Quantity	pounds	3,950,489	2,545,755
Value		$402,035	$192,987
Average price per pound		$0.102	$0.076
Strip and ribbon zinc:			
Quantity	pounds	45,704,052	29,673,527
Value		$5,262,538	$2,902,815
Average price per pound		$0.115	$0.098
Total rolled zinc	pounds	106,467,530	60,800,186
Total value		$12,290,233	$5,940,208
Average price per pound		$0.115	$0.098
Sheet zinc imported and entered for consumption:			
Quantity	pounds	7,572	13,375,245
Value		$614	$496,145
Declared value per pound at foreign mills		$0.081	$0.037
Rolled zinc exported:			
Quantity	pounds	23,704,197	3,631,647
Value		$2,832,993	$425,618
Average price per pound		$0.120	$0.117
Available for consumption	pounds	82,770,905	70,543,784

The following table shows the difference, or "spread," between the average price per pound of grades B and C zinc, which are those used in rolled zinc, and the average price per pound of zinc sheets. During the later part of the World War the great demand for zinc sheets for packing munitions sent the price to a high figure, with a resulting wide difference between the price of sheets and of the metal. The decline in the demand for sheets after the war caused a drop in prices, and the difference was narrowed. In the early part of 1921 sheets were selling at about the old price, but there was a great fall in the price of slab metal, so that the difference was nearly equal to that of war times. This condition, aided by the depressed rates of foreign exchange, led to the importation of large quantities of foreign sheets, principally from Belgium and Germany. In consequence, the domestic price fell off 3 cents from the beginning of the year, which ended with American sheets quoted at 8.5 cents and underselling the foreign product. One effect of this low price for sheet zinc will probably be to advance the movement to increase the use of sheet zinc for roofing.

Difference between prices of slab zinc and zinc sheets, 1917–1921, in cents per pound.

	1917	1918	1919	1920	1921
Average price of sheets	17.5	15.0	10.5	11.5	9.8
Average price of grades B and C	11.1	9.4	7.5	8.3	5.0
Difference	6.4	5.6	3.0	3.2	4.8

ZINC DUST.

Zinc dust produced in the United States, 1917–1921.

Year.	Prepared "blue powder."			Zinc dust "atomized."		
	Short tons.	Value.[a]	Average price per pound.	Short tons.	Value.[a]	Average price per pound.
1917	3,989	$1,322,196	$0.166	1,924	$642,782	$0.167
1918	4,016	877,171	.109	2,979	773,746	.130
1919	[b] 4,083	801,366	.098	[b] 2,515	524,694	.104
1920	[b] 9,066	2,009,117	.111	[b] 2,273	512,833	.113
1921	2,006	333,390	.083	789	120,231	.076

[a] Value is calculated from the total value of material sold during year.
[b] Of the total output of zinc dust in 1919, 385 tons of "blue powder" and 676 tons of "atomized" zinc dust was made from secondary zinc materials. In 1920, 1,179 tons of zinc dust was made from secondary materials, and in 1921, 839 tons.

ZINC PIGMENTS.

Zinc forms the base, either in whole or in part, of four white pigments—zinc oxide, leaded zinc oxide, zinc-lead oxide, and lithopone. Details of the production of zinc pigments and of market conditions are given in the chapter on lead and zinc pigments and salts.

The zinc content of the pigments made in the United States from ore, both domestic and foreign, for the period 1916–1921 is given in the table below. Statistics of the secondary zinc recovered in the form of pigments are given under the next heading.

Primary zinc content of zinc pigments made in the United States, 1916–1921, in short tons.

1916	90,276	1919	96,817
1917	97,573	1920	110,695
1918	102,778	1921	53,480

SECONDARY ZINC.[2]

Secondary zinc recovered in the United States, 1919–1921, in short tons.

	1919	1920	1921
Secondary zinc, redistilled	19,748	21,371	17,573
Secondary zinc, remelted	20,162	21,479	16,260
Recovered zinc in alloys, excluding old brass remelted	6,062	7,650	5,840
Recovered zinc in remelted brass	62,400	65,000	38,627
Secondary zinc recovered as metal	108,400	115,500	78,300
Secondary zinc recovered in zinc dust	955	1,061	755
Secondary zinc recovered in pigments	10,702	12,870	4,024
Secondary zinc recovered in zinc salts	10,018	9,479	10,225
Total secondary zinc	130,000	139,000	93,000

BY-PRODUCT SULPHURIC ACID.

An important by-product of zinc-smelting operations is the sulphuric acid made from the sulphur gases evolved in roasting the zinc sulphide ores preparatory to their distillation or conversion to zinc oxide or to zinc salts. Such statistics of output as were available for the period 1914 to 1920 are given on page 225 of Mineral Resources for 1920, Part I. The canvass of the production of sulphuric acid

[2] See page 21 for definition of secondary zinc.

will hereafter be conducted biennially by the Bureau of the Census. The tabulated results for 1921 are not available for this report but will be included in the chapter on zinc for 1922.

ZINC-REDUCTION PLANTS.

Zinc-smelting plants operating in 1921.

Operating company.	Location of plant.	Retorts.
ARKANSAS.		
Athletic Mining & Smelting Co.	Fort Smith	2,496
Fort Smith Spelter Co.	do.	2,560
ILLINOIS.		
American Zinc Co. of Illinois	Hillsboro	4,864
Do.	East St. Louis	5,620
Eagle-Picher Lead Co.	Hillsboro	3,200
Hegeler Zinc Co.	Danville	5,400
Illinois Zinc Co.	Peru	5,520
Matthiessen & Hegeler Zinc Co.	La Salle	6,132
Mineral Point Zinc Co.	Depue	9,068
Missouri Zinc Co.	Beckemeyer	352
KANSAS.		
Edgar Zinc Co.	Cherrydale	4,984
Weir Smelting Co.	Caney	5,568
OKLAHOMA.		
Bartlesville Zinc Co.	Bartlesville	5,184
Do.	Blackwell	9,600
Eagle-Picher Lead Co.	Henryetta	4,000
National Zinc Co.	Bartlesville	4,256
Quinton Spelter Co.	Quinton	2,016
Tulsa Fuel & Manufacturing Co.	Collinsville	6,232
United States Zinc Co.	Henryetta	3,448
PENNSYLVANIA.		
American Steel & Wire Co.	Donora	8,512
American Zinc & Chemical Co.	Langeloth	7,296
New Jersey Zinc Co. (of Pennsylvania)	Palmerton	7,200
WEST VIRGINIA.		
Grasselli Chemical Co.	Clarksburg	5,760
Do.	Meadowbrook	8,400
United Zinc Smelting Corporation	Moundsville	1,152
		128,820

In addition to the foregoing regular retort smelters, the Trenton Smelting & Refining Co., of Trenton, N. J., operated a plant with large graphite retorts on secondary materials, and the Anaconda Copper Mining Co. operated its electrolytic zinc plant at Great Falls, Mont.

The number of retorts at zinc smelters at the end of 1921 was 128,820 at 25 plants that had operated sometime during the year. The number of retorts in operation at the end of the year was 42,200 at 19 plants, compared with 36,000 retorts in operation June 30 and with 56,000 in operation at the end of 1920.

The following plants had no production in 1921:

Arkansas Zinc & Smelting Corporation, Van Buren, Ark.
Bartlesville Zinc Co., Lanyon-Starr plant, Bartlesville, Okla.
Grasselli Chemical Co., Terre Haute, Ind.
Sandoval Zinc Co., Sandoval, Ill.
United States Zinc Co., Pueblo, Colo.
United States Zinc Co., Kusa, Okla.
United States Zinc Co., Sand Springs, Okla.
Victory Metal Co., Henryetta, Okla.

The following plants were in operation during part of the year but idle at its end:

Eagle-Picher Lead Co., Hillsboro, Ill.
Eagle-Picher Lead Co., Henryetta, Okla.
Fort Smith Spelter Co., Fort Smith, Ark.
National Zinc Co., Bartlesville, Okla.
Tulsa Fuel & Manufacturing Co., Collinsville, Okla.
Weir Smelting Co., Caney, Kans.

TRADE CONDITIONS.

WORLD'S PRODUCTION.[3]

Owing to the disturbed conditions in Europe complete official figures of the world's production of zinc are not available. In the following table the figures in black-faced type are taken from the official statistics of the countries named; those in ordinary type, for years prior to 1921, are taken from the yearbook of the American Bureau of Metal Statistics for 1920, published through cooperation of the American Zinc Institute and associations of lead and copper producers. Figures in ordinary type for 1921 are taken from the preliminary figures of Rudolf Wolff & Co., of London. The official statistics will be substituted in this record as fast as they are made available. Though China is known to smelt considerable zinc no statistics of the output are available, nor have any figures been published for the output of the small smelter at Saltillo, Mexico.

There is always a possibility of duplication in figures showing European production, for some countries send crude zinc of poor quality to other countries for refining. Furthermore, secondary zinc is included in the figures showing the foreign production, so that to put the United States on an equal footing in the statistics it would be necessary to include in the statement of its production figures for the domestic output of secondary zinc.

World's production of zinc, 1913 and 1916–1921.

[In metric tons, by countries where smelted.]

	1913	1916	1917	1918	1919	1920	1921
Australia:							
Tasmania			**49**	**3,883**	**3,727**	**5,911**	1,791
Mainland	**4,187**	**5,362**	**4,769**	**5,712**	**3,625**	**3,909**	
Austria	21,707	11,600	12,600	12,000	(*a*)	(*a*)	240
Belgium	**204,220**	**22,930**	**10,290**	**9,245**	**19,860**	**84,260**	**66,470**
Canada		**2,698**	**9,058**	**11,139**	**11,182**	**16,798**	**24,035**
France	**67,890**	**20,258**	**22,929**	**18,347**	**10,800**	19,655	24,358
Germany:							
Upper Silesia	**169,439**	**122,489**	**128,832**	**122,961**	**74,023**	**81,482**	93,000
Other Germany	109,400	55,326	57,700	48,900	11,000	16,000	
Great Britain	66,213	52,629	51,918	39,001	38,227	25,000	5,776
Italy		**258**	**367**	**1,188**	**1,282**	1,172	380
Japan	900	**38,994**	**54,718**	**39,915**	**19,816**	10,885	7,000
Jugoslavia and Czechoslovakia	(*b*)	(*b*)	(*b*)	(*b*)	4,010	6,000	9,000
Netherlands	**24,323**	**12,101**	**4,059**	**681**		**2,031**	**6,405**
Norway	9,287	1,833	1,752	1,855	3,386	1,837	(*c*)
Poland	(*d*)	(*d*)	(*d*)	(*d*)	**4,652**	**5,361**	6,000
Russia	**10,500**	**1,100**	8,334	4,893	(*e*)	(*e*)	(*e*)
Siberia		**213**	**569**	(*c*)	(*c*)	(*c*)	(*c*)
Spain	**6,003**	**8,523**	**10,155**	**15,900**	**16,314**	**9,647**	3,600
Sweden	**2,115**	**9,997**	**7,979**	**4,098**	**2,321**	**5,759**	(*c*)
United States	**314,498**	**606,307**	**607,423**	**469,853**	**422,513**	**420,366**	**181,890**
Known output	1,010,700	972,600	993,500	810,000	647,000	716,000	

a See Jugoslavia and Czechoslovakia.
b Included in Austria.
c Statistics not available.
d Included in Russia.
e See Poland.

[3] For more complete data see pp. 513–564.

IMPORTS AND EXPORTS.

The following tables of imports and exports of zinc and of zinc remaining in warehouses have been compiled from the publications and records of the Bureau of Foreign and Domestic Commerce of the Department of Commerce by J. A. Dorsey, of the United States Geological Survey.

Zinc remaining in warehouse in the United States, Dec. 31, 1917–1921.

Year.	Ore and calamine.			Blocks, pigs, and old.		Zinc dust.	
	Short tons.	Zinc content (pounds).	Value.	Pounds.	Value.	Pounds.	Value.
1917	96,560	53,997,636	$1,177,680	63,515	$3,949	64,812	$5,710
1918	(a)	53,766,247	1,089,560				
1919	(a)	37,696,007	674,384				
1920	(a)	51,299,109	996,386				
1921	(a)	28,583,018	647,654	262,221	10,911		

a Figures not available.

Zinc imported and entered for consumption in the United States, 1917–1921.

Year.	Blocks or pigs.		Sheets.		Old.		Zinc dust.		Value of manufactures.	Total value.
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.		
1917	18	$2,279	73	$16,570	259	$25,974	233	$48,604	$250	$93,677
1918	11	2,897		29	24	2,056	16	3,552	331	8,865
1919	32	2,284	1	249	37	2,216	52	5,753	1,258	11,760
1920		17	4	614	14	1,065	17	6,207	1,746	9,649
1921	6,598	559,870	6,688	496,445	6	341	42	1,121	8,290	1,066,067

General imports of old brass fit only for remanufacture, 1916–1921.

[Average composition about one-third zinc and two-thirds copper.]

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	22,976	$6,578,809	1919	7,938	$2,157,948
1917	27,580	9,931,721	1920	22,355	5,171,885
1918	6,115	1,774,002	1921	20,449	2,373,082

Because of the relation of the American and European markets and exchange in the last four months of 1920 considerable quantities of American zinc that had been exported were reshipped to the United States, and this condition persisted through the first three months of 1921, as is shown in the table below. The Bureau of Foreign and Domestic Commerce records such imports along with other goods in a general class of "American goods returned" and does not show them specifically in the Monthly Summary. The following figures are taken from the records of the bureau.

American zinc returned, September, 1920–March, 1921.

Month.	Short tons.	Value.	Month.	Short tons.	Value.
September, 1920	1,577	$230,697	January, 1921	369	$31,000
October	3,218	441,190	February	361	30,318
November	2,087	283,845	March	1	51
December	1,280	149,016		731	61,369
	8,162	1,104,748			

General imports of zinc ore into the United States, 1904–1921, in short tons.

Year.	Canada.		Mexico.		Other countries.		Total.	
	Ore.	Zinc content.	Ore.	Zinc content.	Ore.	Zinc content.	Ore.	Zinc content.
1904			2,264				2,264	
1905	4,063		18,074				22,137	
1906	423		54,991				55,414	
1907	1,112		102,005				103,117	
1908	7,406		46,351				53,757	
1909	10,024		104,826				114,850	
1910	4,749	1,922	67,877	23,517			72,626	25,439
1911	2,359	947	36,757	14,986			39,116	15,933
1912	8,015	3,661	35,925	13,606			43,940	17,267
1913	8,899	3,498	17,476	6,160	5,041	3,839	31,416	13,497
1914	11,250	4,467	20,705	7,663	7	2	31,962	12,132
1915	11,992	4,710	57,699	17,804	89,161	35,155	158,852	57,669
1916	21,908	8,790	161,271	51,028	202,785	88,329	385,964	148,147
1917	16,559	5,155	145,358	45,697	49,678	21,622	211,595	72,474
1918	14,987	5,173	53,348	18,426	2,567	1,210	70,902	24,809
1919	10,656	3,878	33,443	11,225	4,550	1,906	48,649	17,009

Country.	1920			1921		
	Ore.	Zinc content.	Value.	Ore.	Zinc content.	Value.
Canada	4,731	1,794	$68,286	1,471	554	$14,453
Mexico	47,453	14,975	497,459	6,050	2,147	43,414
Australia	7,805	3,852	197,192			
Other countries	5,784	1,866	74,315	18	4	833
	65,773	22,487	837,252	7,539	2,705	58,700

The sources of the zinc ore imported from "Other countries" in 1915–1918 are given in the chapter on zinc in Mineral Resources, 1918, Part I, page 1066.

Domestic zinc ore and domestic manufactures of zinc exported from the United States, 1917–1921.

Year.	Zinc ore.		Pigs or slabs.		Plates and sheets.		Zinc dross.		All other manufactures.[a]	Total value.
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.		
1917	1,320	$63,043	137,282	$32,605,767	16,514	$5,730,792	13,302	$2,126,909	$570,352	$41,096,863
1918	62	2,480	66,369	12,469,622	13,875	4,566,756	15,816	2,238,913	722,671	20,000,442
1919			109,746	17,524,153	19,762	5,212,002	5,123	739,295	538,133	24,013,583
1920			74,046	12,495,144	11,852	2,832,993	2,445	316,637	1,057,676	16,702,450
1921			1,753	204,984	1,816	425,618	510	45,340	391,996	1,067,938

[a] Not including brass.

Domestic brass and brass manufactures exported from the United States, 1917–1921.

[Zinc content approximately 30 per cent by weight.]

Year.	Bars, plates, and sheets.		Scrap and old.		Articles made from brass.	Total value.
	Short tons.	Value.	Short tons.	Value.		
1917	164,173	$101,521,426	4,149	$1,758,384	$136,611,299	$239,891,109
1918	15,495	9,522,934	2,455	799,318	19,483,146	29,805,398
1919	3,885	2,310,561	661	176,028	11,426,289	13,912,878
1920	2,905	1,671,608	1,030	254,189	13,202,854	15,128,651
1921	1,437	741,110	2,969	405,871	7,123,366	8,270,347

Foreign zinc exported from the United States in 1917–1921.

Year.	Exported from warehouse.			Exported in manufactures with benefit of drawback, slabs and sheets excluded (short tons).
	Blocks, pigs, and old.		All other manufactures.	
	Short tons.	Value.		
1917	64,680	$12,429,356	$50	1,588
1918	20,069	3,565,127	.....	6,337
1919	12,256	1,943,507	13,071	4,533
1920	28,132	4,331,636	.....	237
1921	1,256	100,677	10,785	130

Domestic and foreign zinc exported from the United States, 1920 and 1921, by destination.

[Figures in parentheses are not duplicated in the totals.]

Destination.	Domestic.				Foreign (slabs).	
	Slabs.		Sheets.			
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1920.						
Africa	.....	.....	45	$11,540	.....	.....
Asia	1,741	$278,440	2,262	544,623	754	$110,962
China	(68)	(11,148)	(209)	(56,330)	.....	.....
Hongkong	.....	.....	(369)	(95,151)	.....	.....
Japan	(1,622)	(276,939)	(1,112)	(264,353)	(698)	(102,052)
Australia and Oceania	20	4,947	244	72,490	.....	.....
Philippine Islands	(19)	(4,511)	(188)	(50,460)	.....	.....
Canada	196	31,845	1,697	416,123	(a)	52
Cuba	7	2,011	46	14,031	.....	.....
Europe	71,016	11,945,681	4,614	1,061,607	27,166	4,186,618
Denmark	(179)	(35,898)	(513)	(101,301)	.....	.....
France	(20,538)	(3,661,340)	(902)	(195,739)	(4,178)	(568,970)
Germany	(1,000)	(168,006)	(10)	(4,000)	.....	.....
Great Britain	(45,433)	(7,431,257)	(1,874)	(448,878)	(22,080)	(3,462,123)
Italy	(560)	(114,050)	(799)	(186,571)	(62)	(9,930)
Mexico	82	16,130	635	148,524	153	24,910
South America	953	199,952	1,988	477,368	59	9,094
Argentina	(671)	(131,611)	(1,062)	(247,106)	.....	.....
Brazil	(197)	(37,813)	(487)	(120,323)	(56)	(8,576)
Other countries	31	16,138	321	86,687	.....	.....
	74,046	12,495,144	11,852	2,832,993	28,132	4,331,636
1921.						
Africa	.....	.....	1	567	.....	.....
Asia	919	105,320	129	41,060	1,120	89,467
China	(100)	(16,079)	(20)	(6,839)	.....	.....
Japan	(819)	(89,241)	(96)	(29,592)	(1,120)	(89,467)
Australia and Oceania	9	1,796	101	29,842	.....	.....
Philippine Islands	(6)	(817)	(66)	(15,046)	.....	.....
Canada	106	10,893	808	159,268	136	11,210
Cuba	(a)	40	35	10,271	.....	.....
Europe	470	55,918	206	56,217	.....	.....
Belgium	(110)	(13,067)	.....	.....	.....	.....
France	(280)	(32,007)	.....	.....	.....	.....
Italy	.....	.....	(23)	(5,308)	.....	.....
Great Britain	.....	.....	(178)	(50,105)	.....	.....
Spain	(73)	(9,648)	.....	.....	.....	.....
Mexico	206	24,106	313	69,380	.....	.....
Panama	.....	.....	31	6,590	.....	.....
South America	39	6,447	105	32,354	.....	.....
Argentina	.....	.....	(26)	(10,585)	.....	.....
Brazil	.....	.....	(3)	(1,112)	.....	.....
Chile	.....	.....	(9)	(2,527)	.....	.....
Colombia	.....	.....	(27)	(7,017)	.....	.....
Peru	.....	.....	(34)	(9,017)	.....	.....
Other countries	4	464	87	20,069	.....	.....
	1,753	204,984	1,816	425,618	1,256	100,677

a Less than 1 ton.

CONSUMPTION.

Primary zinc consumed in the United States, 1917–1921, in short tons.

	1917	1918	1919	1920	1921
Supply:					
Stock Jan. 1—					
In bonded warehouses	90	32			
At smelters	17,508	53,689	41,241	36,793	71,037
Production	669,573	517,927	465,743	463,377	200,500
Imports, foreign	257	35	70	15	6,739
Imports, domestic, returned				8,162	731
Total available	687,428	571,683	507,054	508,347	279,007
Withdrawn:					
Exports, foreign, from warehouse	64,680	20,069	12,256	28,132	1,256
Exports, foreign, under drawback	1,588	6,337	4,533	237	130
Exports, domestic	153,796	80,244	129,508	85,898	3,569
Stock Dec. 31—					
In bonded warehouses	32				131
At smelters	53,689	41,241	36,793	71,037	70,321
Total withdrawn	273,785	147,891	183,090	185,304	75,407
Apparent consumption	413,643	423,792	323,964	323,043	203,600

PRICES AND VALUE.

The fluctuations in the quoted price of the prime western grade of zinc at St. Louis are illustrated in figure 1, which shows graphically for the years 1920 and 1921 the relations of the average weekly St. Louis quoted price of zinc, the weekly average London price of zinc, the weekly average price of 60 per cent zinc blende concentrates at Joplin, Mo., and the weekly sales of concentrates in the Joplin region as a whole. The price of zinc has been taken from market reports; the price of zinc blende and the figures of weekly sales are those published in the Joplin daily papers. To eliminate the sharp weekly fluctuations and to obtain a curve more easily comparable with the price curves, the weekly sales have been averaged by months, the result being shown by the broken line.

The average quotation for prime western zinc at St. Louis in 1921 was 4.7 cents a pound, compared with 7.8 cents in 1920 and 7 cents in 1919. The London average quotation for the year was £25 16s. 10½d. a long ton, compared with £45 4s. 6d. a long ton in 1920.

A canvass of the actual sales of zinc and the prices received in 1921 gives 5 cents a pound as the average selling price of all grades. The average selling price for all grades is the price used in calculating the value of the zinc output of the country.

Prices of zinc, by grades, 1917–1921, in cents per pound.

[Average price received except as otherwise stated.]

	1917	1918	1919	1920	1921
Grade A (high grade)	14.0	11.1	8.3	8.4	5.6
Grade B (intermediate)	12.7	10.7	7.7	8.3	5.5
Grade C (select and brass special)	9.4	8.0	7.2	8.2	4.9
Grade D (prime western)	9.0	7.9	7.1	8.0	4.9
All grades	10.2	9.1	7.3	8.1	5.0
Prime western, average spot quotation at St. Louis	8.9	8.0	7.0	7.8	4.7

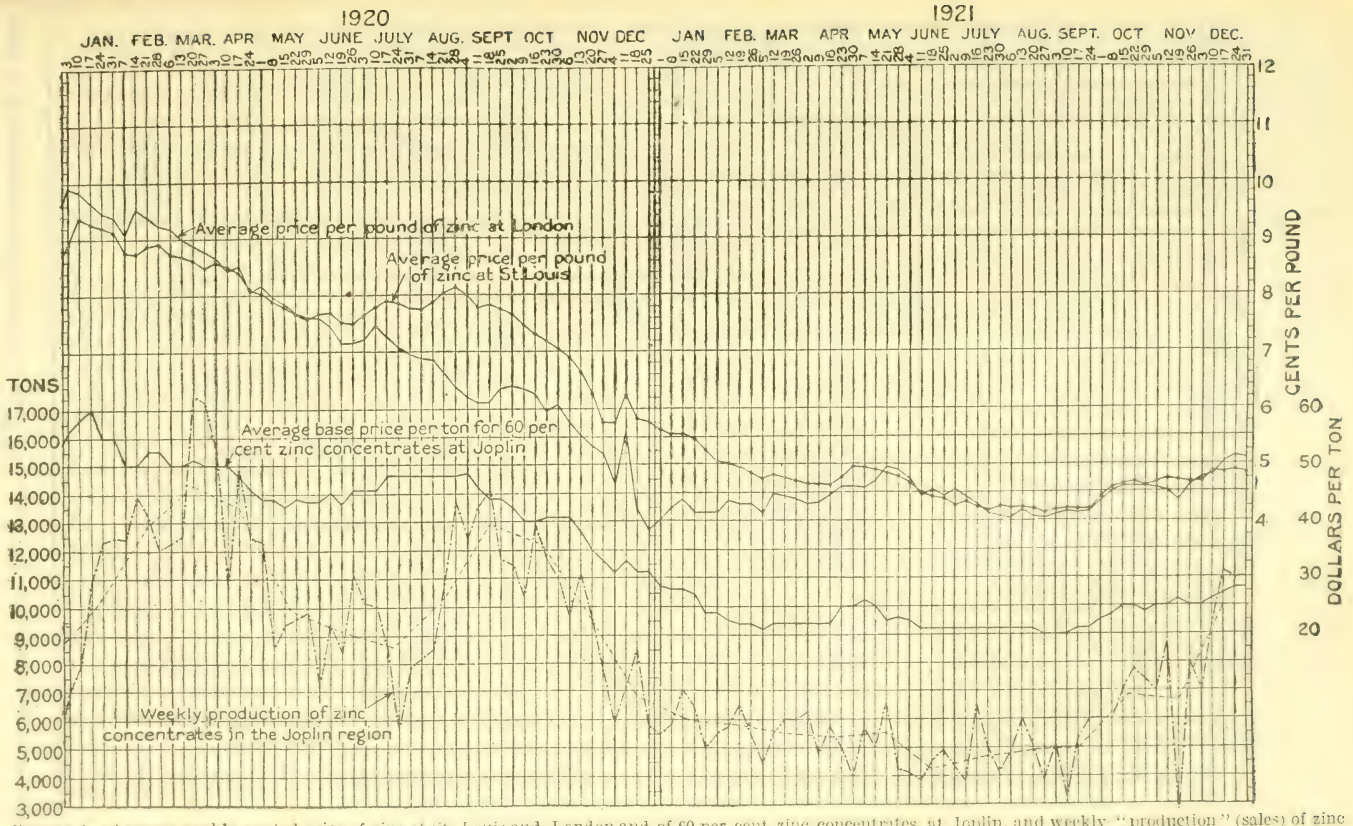

FIGURE 1.—Average weekly quoted price of zinc at St. Louis and London and of 60 per cent zinc concentrates at Joplin, and weekly "production" (sales) of zinc concentrates in the Joplin region, 1920 and 1921. The broken line shows the weekly sales in the Joplin region, averaged by months.

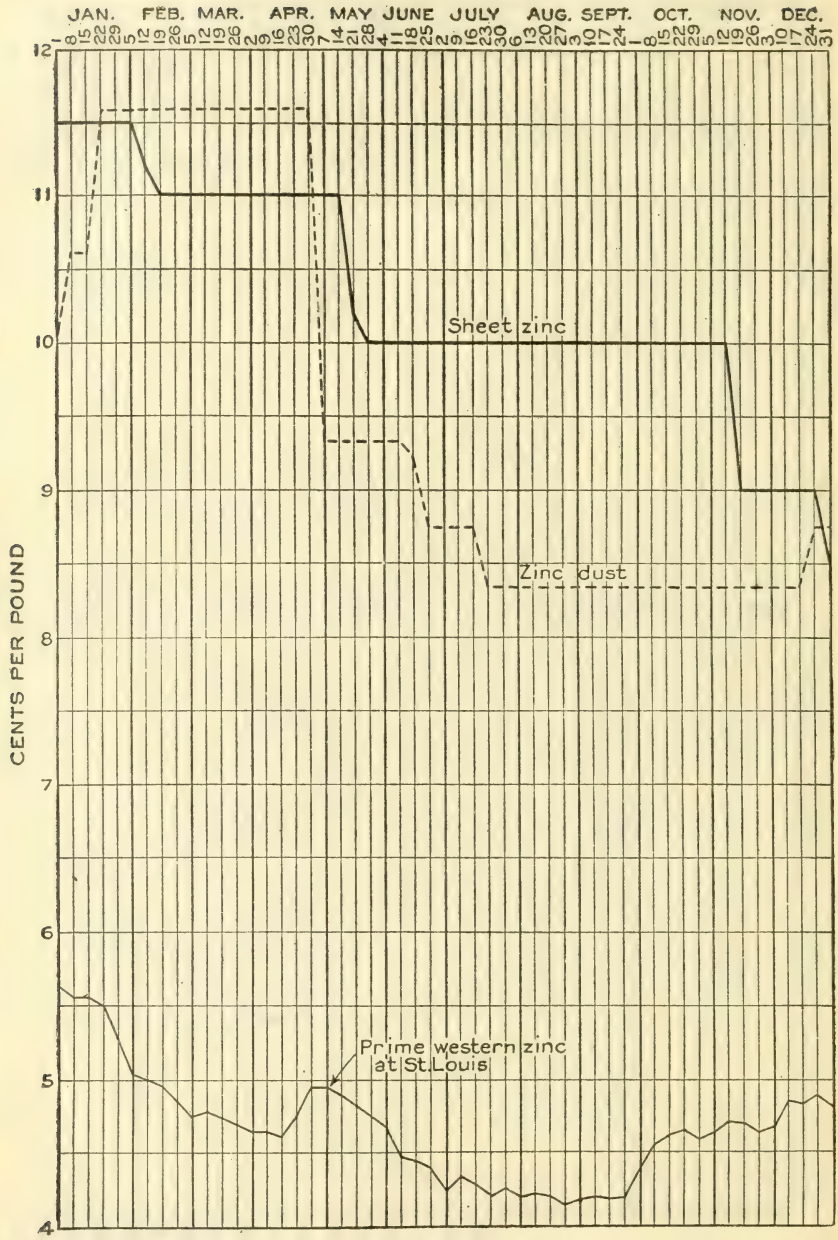

FIGURE 2.—Graphs showing relations of prices of zinc products to those of prime western zinc at St. Louis in 1921.

The market quotation on rolled zinc sheets in mill lots at the smelters at the beginning of 1921 was 11.5 cents a pound, with the usual discounts, but the quotation declined to 8.5 cents a pound at the end of the year as the result of the active competition of foreign sheets. The average selling price of domestic sheets was 10 cents a pound; of strips, 9.8 cents; and of boiler plates and heavy sheets, 7.6 cents. The average selling price of all rolled zinc was 9.8 cents a pound.

At the beginning of 1921 zinc dust was quoted at 10 cents a pound; it soon reached 11¼ to 12 cents and remained at that point until early May, when it broke, reaching 8 to 8¾ cents by the later part of July and remaining at that figure until the end of the year. The average price of zinc dust, "blue powder," as calculated from sales during the year, was 8.3 cents a pound, and "atomized" zinc dust brought 7.6 cents a pound. "Blue powder" brought a higher average price than "atomized" dust because much of it was sold in the Far West, where higher prices prevailed.

Figure 2 shows graphically the average of weekly quotations for prime western slab zinc for prompt delivery at St. Louis and on the same vertical scale the weekly quotations on zinc sheets and zinc dust. The curve for slab zinc is irregular and shows quotations varying daily, but the curves showing quotations on zinc sheets and zinc dust are horizontal for weeks at a time. It should be borne in mind, however, that the quotations on zinc sheets are subject to discounts and that the discounts may fluctuate while the base quotation remains steady.

Distilled and electrolytic zinc produced in the United States, 1917–1921.

Year.	Domestic primary.		Foreign primary.		Redistilled secondary.		Total.	
	Short tons.	Value.[a]	Short tons.	Value.[a]	Short tons.	Value.[a]	Short tons.	Value.[a]
1917.....	584,597	$119,258,000	84,976	$17,335,000	16,835	$3,434,000	686,408	$140,027,000
1918.....	492,405	89,618,000	25,522	4,645,000	9,918	1,805,000	527,845	96,068,000
1919.....	452,272	66,032,000	13,471	1,967,000	19,748	2,883,000	485,491	70,882,000
1920.....	450,045	72,907,000	13,332	2,160,000	21,371	3,462,000	484,748	78,529,000
1921.....	198,232	19,823,000	2,268	227,000	17,573	1,757,000	218,073	21,807,000

[a] Value based on the average selling price for all grades.

LEAD.[1]

By C. E. Siebenthal and A. Stoll.

SUMMARY.

Statistics of refined lead, 1920 and 1921, in short tons.

	1920	1921
PRODUCTION.		
Domestic desilverized lead	220,327	187,062
Domestic soft lead	189,854	157,513
Domestic desilverized soft lead	66,668	52,747
	476,849	398,222
Foreign desilverized lead	52,808	50,367
Total refined primary [a] lead	529,657	448,589
Antimonial lead	12,535	10,064
Secondary [a] lead	124,650	103,780
CONSUMPTION.[b]		
Apparent consumption of primary lead, stocks disregarded	538,620	444,872

[a] "Primary lead," which is produced directly from ore, is here distinguished from "secondary lead," which is obtained by refining skimmings, drosses, and old metals. The statistics of secondary lead are given on p. 38. Wherever in this report the word "lead" is used without qualification it means primary lead.

[b] For method of calculating consumption see p. 41.

The output of refined lead in the United States from domestic ores in 1921 was 398,222 short tons, valued at $35,840,000, at the average selling price of pig lead, a loss, as compared with 1920, of 16 per cent in quantity and of 53 per cent in value.

PRODUCTION.

Production, average price per pound, and value of refined lead in the United States, 1917–1921.

Year.	Desilverized lead.[a,b]	Soft lead.[c]	Total production.[b]	From domestic ores and base bullion.[b]	From foreign ores.	From foreign base bullion.	Average price per pound.	Value.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
1917	422,266	188,503	610,769	548,450	15,872	46,447	$0.086	$105,052,000
1918	429,732	210,463	640,195	539,905	15,334	84,956	.071	90,908,000
1919	334,476	147,741	482,220	424,433	7,656	50,131	.053	51,115,000
1920	339,803	189,854	529,657	476,849	8,414	44,394	.08	84,745,000
1921	291,076	157,513	448,589	398,222	7,110	43,257	.045	40,373,000

[a] Desilverized soft lead is included; for quantity, see p. 37.
[b] Antimonial lead is excluded; for quantity, see p. 37.
[c] Desilverized soft lead is excluded.

[1] Chapters on lead giving more than ordinary detail were published in Mineral Resources for 1908 (historical table of production) and 1918 (the lead industry in relation to the World War).

Quantity and value.—The refined lead produced in the United States from 1720 to 1914 from domestic ores and from foreign ores and base bullion and its value at the average price in New York are shown in a table in the chapter on lead in Mineral Resources for 1914; details for later years are shown in the annual chapters.

Production by States.—In addition to the domestic lead ores smelted in this country, small quantities of domestic lead ore have been exported to smelters in Canada. In 1917 silver-lead ores from Idaho and Montana smelted in Canada produced 4,570 tons of lead. Ores from Washington yielded 1,388 tons of lead at Canadian smelters in 1918 and 3 tons in 1919, but no lead ore from the United States was treated in Canada in 1920 or 1921.

Primary lead smelted or refined in the United States, 1917–1921, by sources, in short tons.

Source of ore.	1917	1918	1919	1920	1921
Domestic ore:					
Alaska	884	531	645	591	773
Arizona	7,456	6,195	5,407	5,987	3,313
Arkansas[a]	300	14	.....	.....	.....
California	11,471	6,228	2,004	2,260	614
Colorado	29,327	29,395	18,867	17,752	12,104
Idaho	174,045	142,640	89,091	117,191	99,707
Illinois[a]	867	1,010	977	948	271
Kansas[a]	2,663	5,023	7,951	8,421	10,939
Kentucky[a]	21	109	83	114	41
Missouri[a]	218,197	187,743	150,341	171,999	151,028
Montana	5,933	17,586	17,513	13,231	11,565
Nevada	12,334	8,726	5,958	8,650	3,553
New Hampshire	.....	.....	16	.....	.....
New Mexico	3,428	5,140	1,418	1,123	384
New York	.....	49	.....	.....	.....
Oklahoma[a]	19,646	58,755	49,984	68,494	46,902
Oregon	.....	6	.....	.....	.....
South Dakota	34	28	18	6	2
Tennessee[a]	.....	843	2,371	2,705	.....
Texas	58	30	8	1	1
Utah	82,081	76,169	65,102	64,006	51,872
Virginia[a]	147	59	.....	.....	.....
Washington	929	906	1,090	2,460	325
Wisconsin[a]	2,930	4,275	3,975	3,841	1,079
Undistributed	145	59	119	201	101
Zinc residues	6,489	5,359	4,887	4,366	713
	579,385	556,878	427,825	494,347	395,287
Foreign ore:					
Africa	1,738	1,519	644	1,171	.....
Australia	.....	282	69	450	.....
Canada	1,100	7,550	1,895	1,186	2,877
Central America	.....	.....	12	22	6
Mexico	7,607	4,798	2,261	2,729	1,912
South America	1,533	1,101	2,537	2,747	2,235
Other foreign	3,894	84	238	109	90
Foreign base bullion:					
Canada	6,750	8,108	567	1,919	1,599
Mexico	39,508	76,809	49,564	42,421	41,648
South America	189	39	.....	54	.....
	62,319	100,290	57,787	52,808	50,367
Grand total	641,704	657,168	485,612	547,155	445,654

[a] The lead produced by these States is nonargentiferous or soft lead.

Soft lead.—The lead ores of the Mississippi Valley are almost free from silver, and the lead produced from them is known as "soft lead."

Soft lead produced in the United States, 1917–1921, in short tons.

Year.	Soft pig lead.			Soft lead recovered in pigments.	Total soft lead.	Total domestic lead.[a]	Soft lead percentage of total domestic lead.
	Undesilverized.	Desilverized.	Total soft pig lead.				
1917	188,503	56,268	244,771	12,870	257,641	574,338	45
1918	210,463	47,418	257,881	13,093	270,974	562,218	48
1919	147,744	67,938	215,682	11,479	227,161	444,250	51
1920	189,854	66,668	256,522	15,960	272,482	500,841	54
1921	157,513	52,747	210,260	10,158	220,418	415,055	53

[a] Includes domestic refined lead, domestic lead in antimonial lead, and domestic lead in pigments.

Antimonial lead.—The production of by-product antimonial lead from argentiferous lead ores derived from all sources, as reported by all lead refineries operating in this country, is shown for the period 1871–1914 in Mineral Resources, 1914, and for 1915–1920 in Mineral Resources, 1920.

By-product antimonial lead produced in the United States, 1917–1921.

Year.	Total lead refined from base bullion (short tons).	Percentage of by-product antimonial lead.	Antimonial lead.					
			From domestic ore (short tons).	From foreign ore (short tons).	Total.			
					Short tons.	Value.	Antimony content.		Lead content, by difference (short tons).
							Short tons.	Percentage.	
1917	365,998	5.1	15,279	3,367	18,646	$3,781,560	2,759	14.8	15,887
1918	382,314	4.9	10,777	7,793	18,570	2,826,350	2,566	13.8	16,004
1919	266,538	5.2	9,674	4,200	13,874	1,513,968	1,943	14.0	11,931
1920	273,135	4.6	9,604	2,931	12,535	1,963,255	2,033	16.2	10,502
1921	238,329	4.2	7,881	2,183	10,064	870,059	1,589	15.8	8,475
Average		4.83						14.8	

Lead pigments.—Leaded zinc oxide, zinc-lead oxide, sublimed white lead, and sublimed blue lead are made directly from ore. Each of these pigments is discussed and the output given elsewhere in this volume in the chapter on lead and zinc pigments and salts. The lead content of pigments smelted directly from ore is given in the fourth column of the first table on this page. The pigments manufactured from pig lead (white lead, red lead, orange mineral, and litharge) are also discussed and the output given in the chapter on lead and zinc pigments.

Secondary lead.—Secondary lead is obtained mainly from skimmings, drosses, old metal, and alloys, such as babbitt, solder, and type metal. The recovery of lead by refining these materials constitutes an integral part of the lead industry.

Secondary lead recovered in the United States, 1917–1921, in short tons.

Year.	Pig lead.	Lead in alloys.	Total recovered lead.	Value.
1917	45,100	48,400	93,500	$16,082,000
1918	41,146	55,954	97,100	13,788,000
1919	55,684	66,416	122,100	12,943,000
1920	56,350	68,300	124,650	19,944,000
1921	46,370	57,410	103,780	9,340,000

TRADE CONDITIONS.

WORLD'S PRODUCTION. [2]

In the following table the figures in black-faced type are taken from the official statistics of the countries named; those in ordinary type, for years prior to 1921, are taken from the 1920 issue of the yearbook of the American Bureau of Metal Statistics, published through cooperation of the American Zinc Institute and associations of lead and copper producers. Those in ordinary type for 1921 are taken from the trade press. The official statistics will be substituted in this record as fast as they are made available.

There is always a possibility of duplication in figures showing world production, for some countries send "work lead" or base bullion to other countries for refining. Furthermore, secondary and antimonial lead are included in the figures showing the foreign production, so that to put the United States on an equal footing in the statistics it would be necessary to include in its production the domestic output of secondary lead and antimonial lead. The figures for the United States represent refined lead that was smelted in this country, whatever the source of the ore.

World's production of lead, 1913 and 1916–1921.

[In metric tons, by countries where the ore was smelted but not necessarily refined. Figures in black-faced type are official.]

Country.	1913	1916	1917	1918	1919	1920	1921
Australia	**110,444**	**134,072**	**144,950**	**163,368**	**83,408**	**7,802**	56,644
Africa: Rhodesia	**295**	**1,263**	**3,722**	**9,935**	**12,859**	**14,836**	17,944
Tunis	(a)	13,696	18,590	**16,533**	(a)	(a)	15,230
Austria-Hungary	24,100	36,500	34,400	33,000	1,764	1,800	(a)
Belgium	**53,590**	**15,560**	**22,745**	**20,630**	**4,225**	**16,040**	(a)
Canada	**17,202**	**19,879**	**20,709**	**17,005**	**16,143**	**13,733**	**28,274**
France	**28,817**	**24,276**	**21,235**	**12,778**	**10,928**	12,000	(a)
Germany: Upper Silesia	**41,300**	**41,620**	**32,960**	**23,960**	**18,580**	**18,008**	(a)
Other Germany	146,700	65,187	53,268	46,000	32,900	36,400	(a)
Great Britain	30,500	12,890	11,430	11,083	10,441	10,000	(a)
Greece	**18,309**	**9,424**	**1,422**	**4,093**	**3,841**	**5,016**	(a)
India (Burma)	**5,951**	**14,011**	**17,233**	**19,380**	**19,396**	24,198	33,721
Italy	**21,674**	**24,362**	**16,237**	**18,332**	**16,530**	15,915	11,500
Japan	**3,777**	**11,371**	**15,807**	**10,769**	**5,771**	4,167	(a)
Mexico	62,000	19,966	46,612	88,503	78,645	84,200	(a)
Russia	**1,523**	**540**	(a)	(a)	(a)	(a)	(a)
South America	2,476	3,872	4,148	4,781	6,565	5,000	(a)
Spain	**198,829**	**147,407**	**176,309**	**169,709**	**125,721**	**175,196**	(a)
Sweden	**1,235**	**2,076**	**3,174**	**2,241**	**827**	**863**	(a)
Turkey	13,900	1,200	3,000	2,500	1,000	1,000	(a)
United States (refined)	**385,643**	**506,490**	**511,942**	**503,702**	**391,982**	**440,221**	**367,718**
	1,168,000	1,106,000	1,160,000	1,178,000	842,000	886,000	.....

a Statistics not available.

[2] For more complete data see pp. 513–564.

IMPORTS AND EXPORTS.

The following tables were compiled from the records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, of the United States Geological Survey.

Lead remaining in warehouse in the United States, Dec. 31, 1917–1921, in pounds.

[Stated in the form in which the material was entered for warehouse.]

	1917	1918	1919	1920	1921
Ore and base bullion	47,853,945	33,997,822	90,952,684	102,440,325	38,371,815
Pigs, bars, and old	5,370,445	944,483	468,154	2,644,576	693,440

Lead imported and entered for consumption in the United States, 1917–1921.

Year.	Lead in ore.		Base bullion.		Pigs, bars, and old.		Sheets, pipe, and shot.		Not otherwise specified.	Total value.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.		
1917	5,438,931	$207,370	6,965,849	$470,539	1,756,223	$85,743	12,538	$2,699	$10,287	$776,638
1918	6,064,902	344,080	3,559,071	180,070	1,139,950	56,694	6,892	624	36,723	618,191
1919	4,106,823	196,363	31,796,693	1,130,937	10,174,115	415,094	8,018	628	17,187	1,760,209
1920	13,700,499	908,619	66,816,820	3,340,600	68,901,959	3,887,821	81,396	5,483	21,328	8,163,851
1921	6,842,807	327,046	56,819,980	1,668,410	61,909,094	1,972,716	3,087	140	11,204	3,979,516

Type metal imported and entered for consumption in the United States, 1917–1921.

Year.	Type metal.		Lead content.	
	Pounds.	Value.	Pounds.	Percentage.
1917				
1918	551,794	$35,938	513,166	93.0
1919	13,394,803	816,642	11,000,498	82.1
1920	29,887,353	1,349,495	25,761,543	86.2
1921	38,971,351	1,191,553	30,706,845	78.8
Average lead content, 1917–1921				82.1

General imports of lead into the United States, 1917–1921, by classes, in pounds.

Year.	Lead in ore.	Base bullion.		Pigs, bars, sheets, and old.	Total lead content.
		Gross weight.	Lead content.		
1917	41,292,876	109,279,997	103,664,970	11,585,974	156,543,820
1918	37,070,340	155,810,003	149,663,889	10,480,531	197,214,760
1919	19,573,856	115,317,160	112,024,518	10,214,753	141,813,127
1920	29,488,816	101,476,550	96,103,603	71,437,108	197,029,527
1921	14,234,039	77,882,834	71,733,838	62,602,534	148,570,411

General imports of lead into the United States, in ore, base bullion, and refined, 1917–1921, by sources, in pounds.

Year.	Canada.	Mexico.	South America.	Europe.	Other countries.	Total imports.
1917	11,738,379	125,782,759	4,556,460	8,945,899	5,520,323	156,543,820
1918	28,225,878	162,259,199	1,962,124	62,510	4,705,049	197,214,760
1919	10,391,115	125,541,614	5,504,416	89,840	286,142	141,813,127
1920	8,199,234	131,815,278	7,085,351	38,766,504	11,163,160	197,029,527
1921	8,127,158	106,406,238	2,381,365	30,224,701	1,430,949	148,570,411

The high price of lead shortly before and during the World War made it profitable to export domestic lead. Beginning in March, 1914, the exports soon reached large quantities, but they declined rapidly after the war.

Refined lead made from domestic ores and exported from the United States, 1914–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1914	58,722	$4,501,674	1918	41,831	$5,889,381
1915	88,306	7,928,518	1919	10,510	1,471,256
1916	100,500	13,494,065	1920	2,730	462,223
1917	53,688	9,560,598	1921	1,624	177,926

By foreign lead exports are meant the exports of lead of foreign origin which has been smelted, refined, or manufactured in this country and then shipped abroad.

Foreign lead exported from the United States, 1917–1921.

Year.	Exported from warehouse.			Exported in manufactures with benefit of drawback (pounds).
	Pigs, bars, and old.[a]		All other manufactures.	
	Pounds.	Value.		
1917	75,304,480	$6,650,157	$900	15,074,947
1918	118,832,344	8,309,798	4,347	6,852,173
1919	81,951,396	4,536,273	44	3,872,130
1920	34,725,501	2,570,535	35,146	12,350,794
1921	50,000,259	2,284,107	613	18,738,927

[a] Since July 1, 1915, the Bureau of Foreign and Domestic Commerce has classed all foreign lead exported as "domestic exports of pigs, bars, etc., produced from foreign."

Domestic and foreign pig lead exported from the United States, 1920–21, by destination.

[Figures in parentheses are not duplicated in the totals.]

Destination.	Domestic.		Foreign.	
	Short tons.	Value.	Short tons.	Value.
1920.				
Asia	566	$96,766	3,653	$569,334
China	(172)	(32,056)		
Japan	(392)	(64,256)	(3,584)	(558,432)
Australia and Oceania	84	15,095	44	6,996
Philippine Islands	(78)	(14,138)	(44)	(6,996)
Canada	364	59,607	1,357	164,338
Cuba	216	39,984	125	17,687
Europe	477	83,992	7,895	1,185,500
Belgium			(952)	(127,029)
Denmark	(34)	(3,797)	(392)	(49,400)
France	(23)	(5,000)	(1,008)	(150,892)
Germany			(588)	(88,695)
Great Britain	(252)	(45,854)	(2,439)	(351,648)
Netherlands	(146)	(24,752)	(1,871)	(309,589)
Sweden			(588)	(99,280)
Mexico	120	21,972	44	9,412
South America	774	121,098	4,203	609,206
Argentina	(a)	(35)	(1,300)	(178,225)
Brazil	(542)	(79,703)	(2,019)	(309,436)
Chile	(30)	(7,211)	(309)	(46,793)
Uruguay			(470)	(58,300)
Panama	58	11,201	40	7,865
Other countries	71	12,508	2	197
	2,730	462,223	17,363	2,570,535
1921.				
Asia	47	4,180	4,206	343,944
Japan	(28)	(2,105)	(4,200)	(343,456)
Australia and Oceania	39	4,258		
Philippine Islands	(36)	(3,977)		
Canada	170	21,406	40	4,405
Cuba	79	9,504	24	4,337
Europe	979	97,013	19,368	1,816,710
Denmark			(112)	(9,865)
France	(616)	(57,927)	(224)	(21,066)
Germany	(224)	(21,063)	(4,420)	(403,279)
Great Britain	(3)	(339)	(13,154)	(1,247,939)
Netherlands	(118)	(15,799)	(1,401)	(130,081)
Mexico	105	13,669	116	13,539
South America	99	14,134	1,243	100,640
Argentina	(26)	(4,000)	(280)	(22,846)
Brazil	(3)	(301)	(839)	(68,165)
Uruguay	(17)	(1,925)	(112)	(8,624)
Panama	28	5,001		
Other countries	78	8,761	3	532
	1,624	177,926	25,000	2,284,107

a Less than 1 ton.

CONSUMPTION.

Apparent consumption of refined primary lead in the United States, refinery stocks disregarded, in short tons, 1917–1921.

	1917	1918	1919	1920	1921
Supply:					
Stock in bonded warehouse Jan. 1	535	2,685	472	234	1,322
Imports of pigs, bars, and old	5,793	5,240	5,107	35,719	31,301
Production	610,769	640,195	482,220	529,657	448,589
	617,097	648,120	487,799	565,610	481,212
Withdrawn:					
Exports of foreign lead—					
From warehouse	37,652	59,416	40,976	17,363	25,000
In manufactures, with benefit of drawback	7,537	3,426	1,936	6,175	9,369
Exports of domestic lead	53,688	41,831	10,510	2,730	1,624
Stock in bonded warehouse Dec. 31	2,685	472	234	1,322	347
	101,562	105,145	53,656	27,590	36,340
Apparent consumption	515,535	542,975	434,143	538,020	444,872

PRICES AND VALUE.

Lead was quoted for immediate delivery in New York at the beginning of 1921 at 4.7 cents a pound in the open market but rose by the end of January to 5.375 cents. The price declined to 4.1 cents a pound the first week in March, after which it improved, reaching 4.5 cents in the later part of June. It then remained for about three months at about 4.5 cents and through the last quarter of the year was about 4.75 cents, closing at about 4.8 cents.

The average quoted price for lead for prompt delivery in New York for the year was 4.7 cents a pound, as compared with 8.2 cents in 1920. The average selling price, figured on the total sales during the year, was 4.5 cents a pound, as compared with 8 cents in 1920. These are the figures used in calculating the value of lead produced from domestic ores in the United States in those years.

Prices quoted on lead by the American Smelting & Refining Co. in 1921, in cents a pound.

Jan. 2 ..... 4.75	Mar. 31 ..... 4.25	June 10 ..... 4.50
Feb. 15 ..... 4.60	Apr. 26 ..... 4.35	June 22 ..... 4.40
Feb. 18 ..... 4.50	Apr. 28 ..... 4.50	Sept. 2 ..... 4.50
Feb. 19 ..... 4.40	May 4 ..... 4.75	Sept. 9 ..... 4.60
Feb. 24 ..... 4.20	May 10 ..... 5.00	Sept. 20 ..... 4.65
Feb. 25 ..... 4.00	June 6 ..... 4.75	Sept. 23 ..... 4.70
Mar. 28 ..... 4.10		

The London price of lead nearly paralleled the New York price but was about 1 cent a pound lower. During the last quarter of the year the London price gained on the New York price, and at the end of the year the two were very nearly equal. These facts are shown in a striking way by the graphs in figure 3.

As stated on page 35, the value of the output of refined lead in the United States from domestic ores in 1921 was $35,840,000 at the average price of refined lead, as compared with $76,296,000 at the average price in 1920, a loss of 53 per cent.

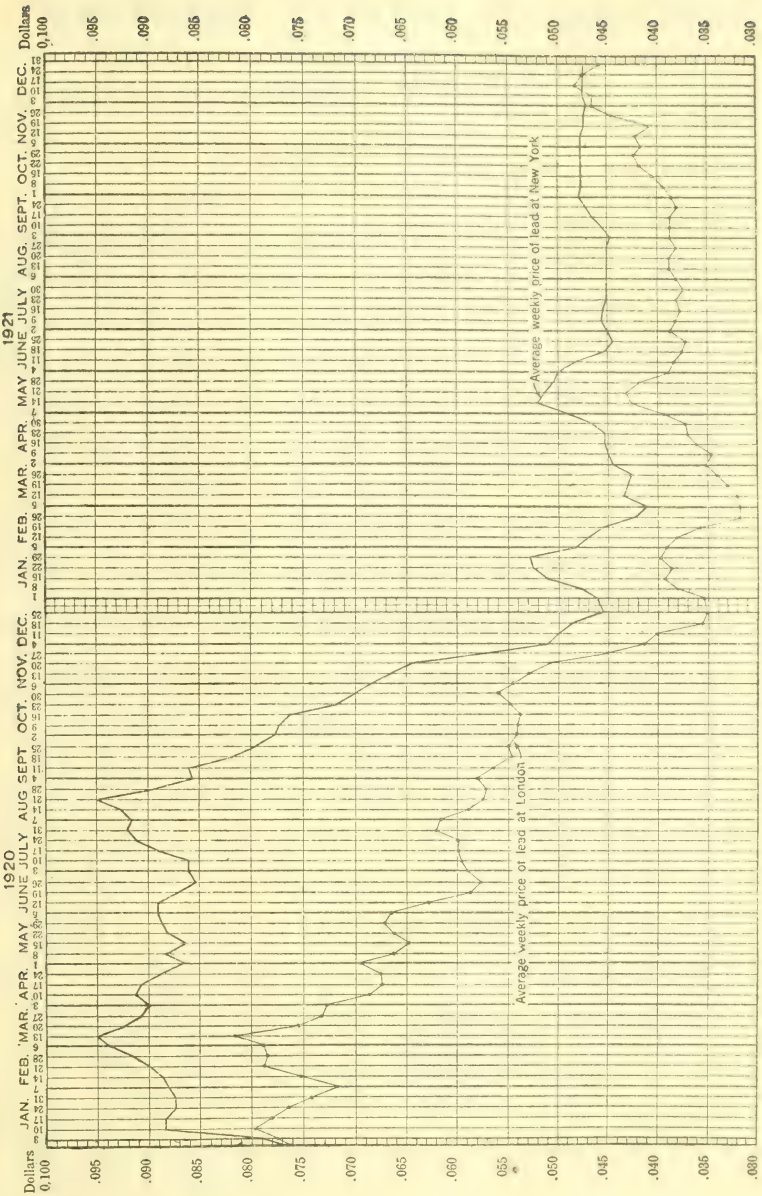

FIGURE 3.—Average weekly quoted price of lead at New York and London, 1920 and 1921.

56026°—M R 1921——12

MANGANESE AND MANGANIFEROUS ORES.[1]

By H. A. C. Jenison.

GENERAL CONDITIONS.

A glance at the accompanying summary of statistics will indicate better than words the great depression in the manganese industry in 1921. The general business depression of the year was only one cause of the smallest domestic production since 1915. The production of steel was undoubtedly very much less in 1921 than in 1920, but a greater production of steel would probably not have greatly increased the consumption of domestic manganese ore, for large quantities of foreign ore were available. The fundamental causes of the decrease were undoubtedly the higher cost of domestic production, the lower grade of the ore, and a greater uncertainty of sufficient supply in comparison with foreign ore.

The accompanying tables show that most of the domestic ore shipped was derived from the Philipsburg district of Montana. The ore from the Philipsburg district is unusual in that it is well suited to chemical uses, and as such enjoys a special market unavailable to the greater part of the domestic high-grade ore.

In considering the future of the domestic industry the reserves of the country must be divided into three classes irrespective of quantity—(1) high-grade chemical ore, (2) high-grade ore and ore capable of beneficiation, and (3) low-grade ferruginous or manganiferous ores.

Aside from any effect of tariff legislation, the future of the ore of the first class is apparently rather bright, as its grade and character and the cost of producing it will probably permit it to be sold in competition with most foreign ore in the domestic chemical market. The most dangerous competitor of this ore is the Russian ore, which apparently is not yet available in large quantities in the United States market.

Most of the ore of the second class can not be mined at a profit under normal conditions in open competition with imported ore. This normal disadvantage, due to grade and cost, has been intensified by the acquisition of high-grade foreign deposits by American capital, particularly by steel producers, who are thus assured of a sufficient supply of high-grade ore, the present cost of which will probably be reduced by the adoption of more efficient methods of mining and transportation.

The ore of the third class includes two varieties which should find a domestic market, regardless of tariff or foreign competition—the manganiferous ore used for flux by the copper, silver, and lead smelters of the West and the ferruginous manganese and manganiferous iron ore used in the manufacture of high manganese pig iron.

[1] The statistical tables in this report were prepared by Miss Helena M. Meyer, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the United States Geological Survey.

The possibility of foreign competition in the domestic market has been summarized by the writer in a recent article,[2] from which the following paragraph is taken:

> The acquisition and development of Brazilian deposits by American and Anglo-American capital, the development of Chilean deposits, the renewal of Russian production upon a modern basis, and the renewal of imports from India promise keen competition among foreign producers for the American market and a selling price of high-grade foreign ore that will be unfavorable to domestic production.

In order to meet this possible competition a tariff of 1 cent per pound of metallic manganese content of imported ores and concentrates containing more than 30 per cent metallic manganese has been acted upon favorably by the House; the Senate committee, however, has placed manganese on the free list. The question of ore reserves in the United States has entered into the discussion of the proposed tariff, and on this subject the reader is referred to the report on manganese and manganiferous ores in Mineral Resources for 1919 and to the correspondence of the Director of the United States Geological Survey, printed in hearings before the Committee on Finance, United States Senate, on the proposed tariff act of 1921 (H. R. 7456), Schedule 3, Metals and manufactures of, page 2096.

SUMMARY OF STATISTICS.

Manganese alloys and ore produced in the United States and imported from important foreign sources, 1917–1921, in gross tons.

Year.	Steel (production).[a]	Ferromanganese.		Spiegeleisen.		Manganese ore.				
		Shipments.	Imports.	Shipments.	Imports.	Shipments.[b]	Total imports.	Imports from—		
								Russia.	India.	Brazil.
1917	45,060,607	260,225	41,969	189,241	3,968	129,351	629,972	.....	48,975	512,517
1918	44,462,432	306,076	27,108	263,861	1,969	305,869	491,303	.....	29,275	345,877
1919	34,671,232	198,255	33,022	90,855	27	54,957	333,344	6,916	9,200	246,592
1920	42,132,934	276,594	59,254	103,672	5,234	94,420	c599,764	18,762	71,238	421,523
1921	19,783,797	111,374	9,077	69,230	307	13,531	c392,606	.....	113,730	262,468

a According to American Iron and Steel Institute.
b Exclusive of small quantities of ore shipped for use in fluxing.
c See table of imports on page 52.

For a discussion of manganese minerals and ore the reader is referred to the report on manganese and manganiferous ores in Mineral Resources for 1919.

MANGANESE AND MANGANIFEROUS ORES.

PRODUCTION AND SHIPMENTS.

The shipments of high-grade manganese ore (containing 35 per cent or more of manganese) during 1921 showed a decrease of 86 per cent in quantity and of 79 per cent in value from 1920. The Emma mine worked by the Anaconda Copper Mining Co., which shipped 56,265 gross tons in 1920, shipped only 28 tons in 1921. Montana, however, still shipped most of the ore in 1921, as in the five preceding years.

The shipments of ferruginous manganese ores (containing 10 to 35 per cent of manganese), exclusive of ore used for fluxing, showed a

[2] Eng. and Min. Jour., Jan. 21, 1922, p. 89.

decrease of 98 per cent in quantity and 97 per cent in value compared with 1920. Minnesota, which has been the principal shipper of this grade of ore for several years, shipped none in 1921. The quantity of this grade of ore shipped for use in fluxing was 22,962 tons in 1921, compared with 123,970 tons in 1920.

The shipments of manganiferous iron ore (containing 5 to 10 per cent of manganese), exclusive of ore used for fluxing and mainly from the Cuyuna district of Minnesota, showed a decrease of 78 per cent in quantity and 77 per cent in value compared with 1920. The Minnesota shipments were but little more than one-fifth of those in the preceding year. Manganiferous ore was shipped from the Dobbins and Norris mines of the Republic Iron & Steel Co. to its own furnaces.

Manganese and manganiferous ore (exclusive of fluxing ore) shipped from mines in the United States in 1921, by States.

State.	Ore containing 35 per cent of manganese or more.			Ore containing 10 to 35 per cent of manganese.			Ore containing 5 to 10 per cent of manganese.		
	Number of shippers.	Gross tons.	Value.	Number of shippers.	Gross tons.	Value.	Number of shippers.	Gross tons.	Value.
Arizona	2	328	(a)						
Arkansas	3	728	$16,360	2	278	$3,683			
Colorado	1	490	(a)	1	924	(a)			
Georgia				1	7,162	(a)	1	6,140	(a)
Michigan				1	51	(a)			
Minnesota							2	56,530	(a)
Montana	3	11,129	444,981						
Tennessee	1	139	3,396	1	24	257			
Virginia	4	717	15,549						
Undistributed			14,811			38,815			$147,576
Total, 1921	14	13,531	495,097	6	8,439	42,755	3	62,670	147,576
Total, 1920	56	94,420	2,396,235	31	357,279	1,450,518	6	279,687	644,572
Total, 1919	42	54,957	1,791,118	24	211,632	965,660	9	112,303	352,570

a Included under "Undistributed." Geological Survey not at liberty to publish.

Ferruginous manganese and manganiferous iron ores shipped from the Cuyuna district, Minn., 1917-1921, in gross tons.

Mine.	Ore containing 10 to 35 per cent of manganese.				
	1917	1918	1919	1920	1921
Algoma (Hoch)	a84,125	21,200	24,478	b5,115	
Arko		733	500	2,044	
Cuyuna Mille Lacs	112,554	132,515			
Ferro	(a)	57,261	14,556		
Gloria			2,637	738	
Hillcrest					
Hopkins		36,651	5,849		
Ida Mae		5,134		b20,851	
Joan, Nos. 1 and 4	8,375	27,931		8,500	
Kennedy					
Mahnomen	4,000	132,726	11,472	9,842	
Mangan, Nos. 1 and 2	52,290	67,796	92	10,979	
Martin		349			
Merritt, Nos. 1 and 2	33,180	78,555		33,239	
Portsmouth					
Sagamore			79,248	163,904	
Sultana	65,018	64,158	120	b38,312	
	359,542	625,009	138,952	293,524	

a Shipments from Ferro mine included with Algoma mine for 1917. Not reported separately to the Geological Survey.
b According to the Iron Trade Review.

Ferruginous manganese and manganiferous iron ores shipped from the Cuyuna district, Minn., 1917–1921, in gross tons—Continued.

Mine.	Ore containing 5 to 10 per cent of manganese.					Total, 1913–1921
	1917	1918	1919	1920	1921	
Algoma (Hoch)	.....	.....	.....	.....	.....	[a] 165,710
Arko	.....	.....	.....	.....	.....	3,277
Cuyuna Mille Lacs	.....	25,560	.....	.....	.....	477,050
Ferro	.....	.....	.....	.....	.....	[a] 86,527
Gloria	.....	.....	.....	.....	.....	3,375
Hillcrest	9,590	20,242	.....	.....	15,473	48,017
Hopkins	.....	.....	.....	.....	.....	42,500
Ida Mae	.....	.....	.....	.....	.....	25,985
Joan, Nos. 1 and 4	.....	.....	.....	.....	.....	44,806
Kennedy	.....	.....	.....	9,511	.....	9,511
Mahnomen	82,000	175,648	90,896	81,066	41,057	671,707
Mangan, Nos. 1 and 2	.....	4,679	.....	.....	.....	166,165
Martin	.....	1,073	.....	.....	.....	1,422
Merritt, Nos. 1 and 2	.....	.....	.....	.....	.....	144,974
Portsmouth	.....	.....	.....	158,336	.....	158,336
Sagamore	.....	.....	7,324	.....	.....	250,476
Sultana	.....	.....	.....	.....	.....	202,978
	91,590	227,202	98,220	248,913	56,530	2,502,816

[a] Shipments from Ferro mine included with Algoma mine for 1917. Not reported separately to the Geological survey.

Manganiferous silver ore shipped, 1917-1921, in gross tons.[a]

Year.	Arizona.	Colorado.		Nevada.	New Mexico.	Utah.
		For fluxing.	For other purposes.			
1917	32,409	[b] 20,600	[b] 104,115	122,872	.....	100
1918	10,854	24,931	99,110	80,096	475	.....
1919	1,964	29,769	11,055	77,815	250	.....
1920	345	34,670	11,056	95,142	541	.....
1921	.....	10,819	924	14,871	300	.....

[a] All used for fluxing except that from Colorado designated "For other purposes."
[b] Revised figures.

In view of the present interest in manganese the following table of total production of high-grade manganese ore in the United States from 1838 to 1921 has been compiled. As a separation of fluxing and other manganiferous ore prior to 1910 is not possible, tables are added showing separately the shipments of these two classes of ore from 1910 to 1921. Probably without exception the manganese contained in fluxing ore is paid for on the same basis as iron, as manganese acts in the smelting of copper, lead, and silver ores in the same manner as iron and has only a slightly greater fluxing value. Smelting companies are therefore interested in the total content of iron and manganese, and the absence of manganese in fluxing ore is of no consequence so long as the content of iron is sufficiently high. The manganese in fluxing ore is therefore incidental and has no effect upon the domestic manganese market.

Large quantities of maganiferous silver ore and argentiferous manganese ore are bought primarily for fluxing, and the silver is paid for only if it exceeds about 1.5 ounces per ton. Such ore is of no more value than iron ore of the same grade containing the same quantity of silver. As may be seen from the accompanying tables, large quantities of fluxing ores are produced annually, but they must

be disregarded in the consideration of the domestic production of manganese ore for the true manganese market—that is, the steel and chemical industries.

Manganese ore (containing 35 per cent of manganese or more) produced [a] in the United States, 1838–1921, in gross tons.

State.	1838–1916[b]	1917	1918	1919	1920	1921	Total, 1838–1921[b]
Alabama	314	264	709	40	57	.....	1,384
Arizona	3,399	14,802	17,612	529	2,402	328	39,072
Arkansas	57,482	10,140	7,731	2,558	3,445	728	82,084
California	22,036	14,196	24,067	11,289	1,733	.....	73,321
Colorado	260	60	4,821	11,166	3,643	490	20,440
Georgia	99,516	3,614	6,679	48	341	.....	110,198
Indian Territory (Oklahoma)	206	.....	.....	.....	.....	.....	206
Michigan	137	.....	.....	.....	.....	.....	137
Missouri	44	.....	.....	.....	.....	.....	44
Montana	6,555	61,109	199,932	24,993	76,441	11,129	380,159
Nevada	345	3,450	19,872	78	1,240	.....	24,985
New Jersey	.....	.....	64	.....	.....	.....	64
New Mexico	.....	2,603	3,126	.....	2,053	.....	7,782
North Carolina	181	102	315	.....	.....	.....	598
Oregon	.....	.....	198	.....	.....	.....	198
Pennsylvania	1,113	.....	.....	.....	.....	.....	1,113
South Carolina	1,367	405	100	.....	.....	.....	1,872
South Dakota	19	.....	31	.....	.....	.....	50
Tennessee	3,054	1,996	4,162	328	502	139	10,181
Texas	.....	25	380	.....	.....	.....	405
Utah	5,177	4,195	5,100	.....	.....	.....	14,472
Vermont	1,625	.....	.....	.....	.....	.....	1,625
Virginia	254,377	12,360	10,928	3,928	2,523	717	284,833
West Virginia and other States	1,198	.....	.....	.....	.....	.....	1,198
Wyoming	.....	30	42	.....	40	.....	112
	458,405	129,351	305,869	54,957	94,420	13,531	1,056,533

[a] Beginning with 1910 figures represent shipments and exclude fluxing ore.
[b] Prior to 1916 some States in some years produced insignificant quantities of manganese ore. Some of these quantities could not be published separately without disclosing confidential information, so they were included with totals for other States. The quantities so included are more or less compensating and are too small to affect State totals materially.

Manganese and manganiferous ore shipped from mines in the United States, 1910–1921, in gross tons.

Year.	Manganese and manganiferous ores exclusive of fluxing ore.			Fluxing ore containing manganese.		
	Ore containing 35 per cent of manganese or more.	Ore containing 10 to 35 per cent of manganese.	Ore containing 5 to 10 per cent of manganese.	Ore containing 35 per cent of manganese or more.	Ore containing 10 to 35 per cent of manganese.	Ore containing 5 to 10 per cent of manganese.
1910	2,258	.....	.....	.....	41,260	19,841
1911	2,457	2,602	82	.....	34,982	6,771
1912	1,664	2,782	117	.....	38,081	10,537
1913	4,048	9,650	.....	.....	41,862	7,891
1914	2,635	60,484	.....	.....	31,182	6,599
1915	9,558	64,204	10,616	55	116,749	[a] 4,166
1916	31,474	316,600	81,615	.....	137,253	[b] 8,858
1917	129,351	576,608	108,409	54	154,151	[c] 21,776
1918	305,869	818,003	236,103	.....	98,160	[d] 18,196
1919	54,957	211,632	112,303	365	98,202	[e] 11,596
1920	94,420	357,279	279,687	.....	123,970	[f] 6,728
1921	13,531	8,439	62,670	.....	22,962	[g] 3,028
	652,222	2,428,283	891,602	474	938,814	125,987

[a] Includes 796 tons of ore containing less than 5 per cent of manganese.
[b] Includes 1,026 tons of ore containing less than 5 per cent of manganese.
[c] Includes 141 tons of ore containing less than 5 per cent of manganese.
[d] Includes 1,684 tons of ore containing less than 5 per cent of manganese.
[e] Includes 844 tons of ore containing less than 5 per cent of manganese.
[f] Includes 1,250 tons of ore containing less than 5 per cent of manganese.
[g] Includes 998 tons of ore containing less than 5 per cent of manganese.

Though manganese ore has been produced in some quantity since 1838, the annual production before the World War was inconsequential, averaging less than 5,900 gross tons. The total production from 1916 through 1920 was greater than in the previous 78 years, and the production in 1921, in spite of the unfavorable conditions, was more than double the average of the period 1838–1916.

Montana's total production is the greatest and has been made almost entirely since 1916, from the oxide ores of the Philipsburg district and the pink (rhodochrosite) ores of Butte. California, Arizona, Colorado, and Nevada, which made a very large production during the war, were also unimportant producers before the war. On the contrary, Virginia, Georgia, and Arkansas, which are the oldest producers and which made the largest pre-war production, have produced during and since the war only a small part of their total. Montana, California, and Arizona made by far the largest production during the war, and each of them during the period 1917–1921 produced more ore than either Virginia, Georgia, or Arkansas.

It thus took a great national emergency to develop a domestic manganese industry, and the emergency was met principally by new producers in Western States. The old producing States failed to increase their production greatly, even under these unusual stimulating conditions. This failure was probably due in general to smallness of undeveloped reserves and to exhaustion of reserves capable of immediate extraction or of competition with the western and foreign deposits.

In spite of the long period of manganese mining and the extensive exploratory efforts during the war, Montana is the only State that has developed large reserves of high-grade ore and is the only one likely to make a large output of such ore under normal conditions. The future extent of production in California, Arizona, Nevada, and Colorado is more uncertain. Under favorable conditions they may retain their lead over the older producers, but their prospective output and reserves are small compared with those of Montana.

In summary it is interesting to note that the center of production of high-grade ore has moved west of the Rockies, and that the total production of high-grade ore of the United States for the 84 years ended in 1921 only slightly exceeded the quantity of high-grade ore required in 1918 by the domestic steel industry alone.

For a discussion of the value and uses of manganese ores the reader is referred to the report on manganese and manganiferous ores in Mineral Resources for 1919.

PRODUCTION IN PRINCIPAL COUNTRIES.[3]

Manganese ore produced in principal producing countries, 1915–1920, in metric tons.

Country.	Percentage of manganese.	1915	1916	1917	1918	1919	1920
North America:							
Canada	.....	182	868	143	399	600	589
Costa Rica	37–48	.....	*a* 1,475	*a* 8,080	*a* 10,168	*b* 10,148	*b* 2,452
Cuba	36–44	*b* 5,223	*b* 31,054	*b* 45,225	*b* 84,306	*b* 35,887	*b* 8,379
Mexico	40+	.....	.....	73	2,878	2,294	839
Panama	50±	.....	*b* 10,666	*b* 5,285	*b* 5,696	*b* 2	.....
Porto Rico	35+	.....	*a* 749	*a* 1,208	*a* 1,372	(*c*)	(*c*)
United States	35+	9,767	31,978	131,427	310,778	55,839	95,935
South America:							
Brazil	38–50	*a*288,671	*a*503,130	*a*532,855	*a*393,388	*a*205,725	*a* 453,737
Chile	40–48	.....	.....	*b* 205	*b* 3,046	*b* 448	*b* 12,765
Europe:							
Austria	.....	11,926	(*c*)	(*c*)	(*c*)	5,267	(*c*)
Belgium	.....	500	3,870	2,040	2,610	.....	.....
Bosnia and Herzegovina	.....	10,422	22,674	48,851	(*c*)	(*c*)	(*c*)
France	30+	10,324	10,807	11,589	9,871	7,016	5,697
Hungary	.....	11,709	(*c*)	90,269	(*c*)	100	.....
Italy	18–45	12,577	18,147	24,532	31,896	30,841	29,140
Russia	41–48	*ad* 8,844	*ad* 8,862	(*cd*)	(*cd*)	(*c*)	(*c*)
Spain	29+	14,328	14,178	57,474	77,714	66,685	21,256
Sweden	.....	7,733	9,048	20,027	16,648	12,400	11,250
United Kingdom	30+	4,714	5,222	10,101	17,736	12,272	13,082
Africa:							
Egypt	.....	(*c*)	(*c*)	(*c*)	(*c*)	48,743	77,562
Gold Coast	.....	.....	(*e*)	(*e*)	30,777	35,754	44,310
Tunis	.....	1,460	2,027	5,970	820	1,313	(*c*)
Asia:							
China	.....	.....	.....	*b* 20	*b* 3,048	*b* 1	*b* 3,437
India	47–52	457,646	664,704	600,296	526,266	546,630	*f* 591,987
Japan	50+	25,871	49,310	51,374	*g* 29,759	*g* 22,877	(*c*)
Oceania:							
Australia	40+	556	1,292	290	9,034	5,049	(*c*)
Dutch East Indies	.....	.....	.....	.....	1,450	2,915	4,179
Other countries *h*	.....	*h* 956	*h* 6,600	*h* 112	*h* 2,044	*h* 2,693	*h* 986

a Exports.
b Imports into the United States. Production and exports not available.
c Not available.
d According to an article by D. Ghambashidze, F. R. G. S., delegate of the Georgian Government, in "The mineral resources of Georgia and Caucasia," manganese production in the Georgian Republic was 954,645 tons in 1913, 652,354 tons in 1914, 258,220 tons in 1915, 247,000 tons in 1916, 201,380 tons in 1917, and 150,000 tons in 1918.
e Shipments June, 1916, to November, 1917, 31,482 metric tons.
f Figures cover Burma only.
g Official figures covering all mines that produced over 375 metric tons. Unofficial figures for all mines were 59,000 metric tons for 1918, but are not yet available for 1919.
h Includes Germany in 1915, Greece in 1915 and 1916, New Caledonia in 1918 and 1919, the Philippine Islands in 1916 and 1918, Portugal in 1919 and 1920, and the Union of South Africa in 1917–1920. There was "no production" reported in Greece in 1917, 1919, and 1920; in New Caledonia 1915, 1916, and 1917; in the Philippine Islands in 1919; or in the Union of South Africa in 1915 or 1916. In all other instances where the years are not mentioned here the figures are not available.

[3] For more complete data see pp. 513–564.

IMPORTS.

The following table was compiled from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce:

Manganese ore imported into the United States, 1920–1921.

Country.	1920		1921	
	Gross tons.	Value.	Gross tons.	Value.
Africa	31,927	$123,415	8,453	$27,198
Argentina	(a)	(a)	(a)	(a)
Australia				8
Brazil	421,523	8,833,493	262,468	1,952,848
Canada	828	28,509	(a)	(a)
Chile	12,563	312,794		
China	3,383	126,648		
Costa Rica	2,413	60,325	588	17,658
Cuba	8,247	266,744	34	679
Czechoslovakia	1,874	58,602		
France	(a)	(a)		
Germany	(a)	(a)	(a)	(a)
Honduras			14	140
Hongkong	9,520	207,441	7,319	131,052
India (British)	71,238	551,660	113,730	734,516
Japan	(a)	(a)	(a)	(a)
Mexico	2,925	55,449		
Oceania (French)	7,510	75,316		
Russia	18,762	858,804		
Turkey	(a)	(a)		
United Kingdom	7,049	243,564	(a)	(a)
Venezuela	2	111		
	a 599,764	a 11,802,875	a 392,606	a 2,864,099

a In 1920, 7,173 gross tons, valued at $428,047, ranging in value from $50 to $292 per ton, and in 1921, 8,748 tons, valued at $501,633, ranging in value from $46 to $128 per ton, were also reported by the Bureau of Foreign and Domestic Commerce as imports of manganese ore from countries designated "a". It is extremely unlikely that manganese ore could have been valued so highly as these statistics indicate; consequently these figures probably represent imports of ferromanganese, spiegeleisen manganese chemicals, and perhaps some chemical ore. Exact determination of the character of this material is impossible.

MANGANIFEROUS ZINC RESIDUUM.

Manganiferous zinc residuum containing 12 to 15 per cent of manganese and 40 per cent of iron was recovered, as in former years, from the roasted franklinite concentrates at Franklin Furnace, N. J., and was smelted to spiegeleisen.

Manganiferous residuum produced from zinc roasting in the United States and shipped, 1916–1921, in gross tons.

1916	198,817	1919	80,418
1917	155,332	1920	133,602
1918	146,796	1921	12,627

FERROMANGANESE AND SPIEGELEISEN.

For a discussion of the manufacture, specifications, and uses of ferromanganese and spiegeleisen the reader is referred to the report on manganese and manganiferous ores in Mineral Resources for 1919.

The firms that make ferromanganese and spiegeleisen are listed below (f indicates ferromanganese; s, spiegeleisen):

fs..American Manganese Manufacturing Co., Dunbar, Pa.
f...Anaconda Copper Mining Co., Great Falls, Mont.
fs..Bethlehem Steel Corporation, Lebanon, Pa.
f...Bilrowe Alloys Co., Tacoma, Wash.
fs..Cambria Steel Co., Widener Building, Philadelphia, Pa.
f...Donner Steel Co., North Tonawanda, N. Y.
f...Electro Metallurgical Co., Niagara Falls, N. Y.
f...Ferro Alloy Co., Utah Junction, Colo.
fs..Juniata Furnace & Foundry Co., Newport, Pa.
fs..Lackawanna Steel Co., Buffalo, N. Y.
f...Lavino Furnace Co., Lebanon, Pa.
fs..Lavino Furnace Co., Marietta, Pa., and Reusens, Va.
s...Lavino Furnace Co., Sheridan, Pa.
fs..E. E. Marshall, Harrisburg, Pa.
s...New Jersey Zinc Co., Palmerton, Pa.
fs..Southern Manganese Corporation, Anniston, Ala.
f...Steel & Tube Co. of America, South Chicago, Ill.
fs..Tennessee Coal, Iron & Railroad Co., Bessemer and Birmingham, Ala.
f...Tennessee Manganese Co., Cleveland, Tenn.
f...United States Ferro Alloy Co., Niagara Falls, N. Y.
fs..United States Steel Corporation, Chicago, Ill., and Pittsburgh, Pa.

Ferromanganese and spiegeleisen shipped from furnaces in the United States, 1916–1921.

Year.	Ferromanganese.		Spiegeleisen.	
	Gross tons.	Value.	Gross tons.	Value.
1916	224,103	$30,123,493	182,837	$6,158,202
1917	260,225	53,930,771	189,241	9,756,236
1918	306,076	69,045,678	263,861	17,276,494
1919	198,255	27,093,816	90,855	3,965,754
1920	276,594	41,840,690	103,672	5,289,049
1921	111,374	13,654,800	69,230	2,838,692

Ferromanganese and spiegeleisen imported for consumption in the United States, 1916–1921.

Year.	Ferromanganese.		Spiegeleisen.	
	Gross tons.	Value.	Gross tons.	Value.
1916	90,928	$9,240,528		
1917	41,969	5,710,988	3,968	$291,594
1918	27,168	4,258,745	1,969	228,012
1919	33,022	4,283,541	27	1,018
1920	59,254	7,775,278	5,234	277,900
1921	9,077	888,419	307	10,472

The following records of average contract prices of ferromanganese and of spiegeleisen by months for the last four years show a wide range. The ferromanganese prices are prices for material delivered; the prices of spiegeleisen are prices at furnaces. (See also fig. 4.) Prices on ferromanganese from May, 1918, to and including January, 1919, are based on 70 per cent of manganese and other prices on 80 per cent; prices on spiegeleisen from April, 1918, to and including June, 1919, are based on 16 per cent of manganese and other prices on 20 per cent.

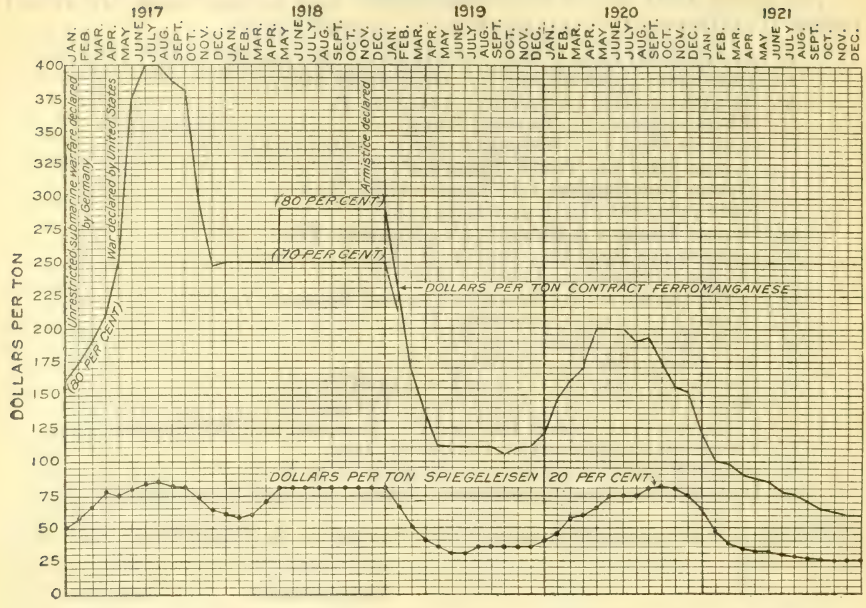

FIGURE 4. Diagram showing contract prices of ferromanganese and spiegeleisen, 1917–1921.

Prices per gross ton of ferromanganese and spiegeleisen, 1918–1921.[a]

Month.	Ferromanganese.				Spiegeleisen.			
	1918	1919	1920	1921	1918	1919	1920	1921
January	$250.00	$212.50	$146.00	$101.00	$59.00	$67.50	$46.60	$46.25
February	250.00	165.00	160.00	96.85	59.00	52.50	57.60	37.75
March	250.00	134.00	172.00	89.00	65.50	42.50	60.40	34.20
April	250.00	113.75	200.00	87.50	70.00	34.50	66.85	32.00
May	250.00	110.00	200.00	83.00	71.00	31.35	75.00	31.75
June	250.00	111.75	198.00	76.50	75.00	27.50	75.00	29.60
July	250.00	111.00	190.00	75.00	75.00	34.00	75.00	27.50
August	250.00	110.00	193.75	70.75	75.00	34.00	79.35	26.20
September	250.00	105.00	172.40	64.75	75.00	34.00	82.00	25.25
October	250.00	110.00	156.40	61.65	75.00	34.00	80.00	24.85
November	250.00	110.00	153.00	60.00	75.00	34.00	74.35	25.00
December	236.00	121.00	120.00	60.00	72.50	39.00	64.40	25.00

[a] Iron Trade Review.

LEAD AND ZINC PIGMENTS AND SALTS.

By C. E. Siebenthal and A. Stoll.

PRODUCTION.

Lead and zinc pigments and salts are made both by smelting and by chemical processes. Sublimed lead, basic sulphate lead, and the various lead oxides are examples of lead pigments produced by sublimation in oxidizing furnaces; basic carbonate white lead and the lead salts are made by chemical processes. Sublimed lead is made directly from ore, but the lead oxides as well as white lead and lead salts are made from pig lead.

Zinc oxide and leaded zinc oxide are made by the American process directly from ore by sublimation in an oxidizing furnace, but some zinc oxide is made in this country by the French process, in which metallic zinc is sublimated in an oxidizing furnace. Lithopone and zinc salts are made by chemical processes, the zinc base being derived from zinc ore, metallic zinc, galvanizers' ashes, or scrap zinc. Lithopone is made by mixing equivalent portions of solutions of zinc sulphate and barium sulphide, which brings about a mutual precipitation of zinc sulphide and barium sulphate either in chemical combination or as a very intimate mixture.

Unless stated to the contrary the statistics of production given herein represent sales. As the imports and exports are approximately equal from year to year the domestic production thus represented is nearly equal to the domestic consumption.

Lead pigments and salts marketed in 1920 and 1921.[a]

	1920			1921		
	Short tons.	Value.		Short tons.	Value.	
		Total.	Per ton.		Total.	Per ton.
Sublimed lead:[b]						
White	12,412	$2,083,647	$167.87	11,568	$1,418,403	$122.61
Blue	928	153,657	165.58	463	58,593	126.55
Red lead[c]	34,431	7,523,089	218.50	21,805	3,414,452	156.59
Orange mineral[c]				381	91,887	241.17
Litharge	62,329	12,386,185	198.72	41,909	5,735,824	136.86
White lead:						
Dry	33,678	6,351,798	188.60	26,738	3,755,418	140.45
In oil	112,017	25,986,100	231.98	143,545	27,505,145	191.61

[a] Statistics for lead arsenate and lead acetate collected biennially by the Bureau of the Census. Figures for 1921 are not yet available.
[b] Includes basic sulphate lead.
[c] Figures for red lead and orange mineral in 1920 not separated.

Zinc pigments and salts marketed in 1920 and 1921.[a]

	1920			1921		
	Short tons.	Value.		Short tons.	Value.	
		Total.	Per ton.		Total.	Per ton.
Zinc oxide	99,444	$17,859,736	$179.60	74,329	$11,231,716	$151.11
Leaded zinc oxide	30,460	4,467,532	146.67	16,103	2,092,320	129.93
Lithopone	89,373	12,484,925	139.69	55,016	6,681,563	121.45
Zinc chloride, 50° Baumé	68,945	4,421,718	64.13	59,457	3,552,619	59.75
Zinc sulphate	3,072	221,582	72.13	3,295	189,369	57.47

[a] The figures for zinc chloride and zinc sulphate in 1920 represent actual production.

SOURCE.

Metal content of lead and zinc pigments and salts, 1920 and 1921, by sources, in short tons.

Source.	1920				1921			
	Lead.		Zinc.		Lead.		Zinc.	
	Pigments.[a]	Salts.	Pigments.	Salts.	Pigments.[a]	Salts.	Pigments.	Salts.
Domestic ore	15,212	.....	106,257	6,284	9,989	.....	52,087	3,749
Foreign ore	808	.....	4,438	.....	169	.....	1,393	.....
Metal	215,431	.....	16,786	110	200,599	.....	7,465	528
Secondary material	.....	.....	[b] 12,870	[b] 9,479	.....	.....	[b] 4,024	[b] 10,225
	231,451	.....	140,351	15,873	210,757	.....	64,969	14,502

[a] Includes lead from zinc oxide and leaded zinc oxide.
[b] Zinc ashes, skimmings, drosses, and old metal.

IMPORTS AND EXPORTS.

The following statistics of imports and exports of lead and zinc pigments and salts have been compiled from the publications or records of the Bureau of Foreign and Domestic Commerce, Department of Commerce, by J. A. Dorsey, of the United States Geological Survey.

Basic carbonate white lead, red lead, litharge, and orange mineral imported and entered for consumption in the United States, 1917–1921.

Year.	Basic carbonate white lead.		Red lead.		Litharge.		Orange mineral.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1917	20,238	$1,965	50	$13	.....	.....	33,294	$4,892
1918	508	202	5	1	100	$12	.....	.....
1919	21,213	2,490	7,199	1,136	.....	.....	39,781	5,082
1920	159,977	19,449	23,076	1,789	21,002	2,647	52,094	5,352
1921	124,176	12,598	12,236	689	100	7	77,937	7,830

Zinc oxide, lithopone, zinc chloride, and zinc sulphate imported and entered for consumption in the United States, 1917–1921.

Year.	Zinc oxide.				Lithopone.[a]		Zinc chloride.		Zinc sulphate.	
	Dry.		In oil.							
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1917	119	$52,649	5	$876	229	$35,718	2	$403	(b)	$57
1918	162	62,703	4	1,043	1	993	98	15,177	.....	.....
1919	105	44,338	3	1,351	744	127,121	1	192	(b)	152
1920	1,431	289,890	14	3,596	1.736	278,267	565	76,495	50	3,038
1921	1,286	145,071	57	17,549	5,294	440,349	2,199	213,995	17	820

[a] This heading includes imports of lithopone and "zinc sulphide white." The imports for 1918 consisted of 2,670 pounds of "zinc sulphide white" and no lithopone; hence the high value.
[b] Less than 1 ton.

White lead and red lead exported from the United States, 1917–1921.

	White lead.		Red lead.	
	Short tons.	Value.	Short tons.	Value.
1917	9,869	$2,089,659	[a] 1,086	[a] $267,238
1918	7,794	1,756,739	2,870	662,584
1919	14,017	3,037,292	3,114	735,177
1920	14,901	3,195,101	1,532	365,575
1921	5,161	993,130	548	115,500

[a] July 1–Dec. 31, inclusive. Not separately classified prior to July.

White lead exported from the United States in 1920 and 1921.

[Figures in parentheses not duplicated in totals.]

Destination.	1920		1921	
	Short tons.	Value.	Short tons.	Value.
Africa	42	$9,427	18	$5,253
Asia	300	69,613	52	13,398
Australia and Oceania	1,315	327,997	226	50,817
Australia	(308)	(71,081)	(16)	(3,299)
New Zealand	(502)	(136,497)	(21)	(4,697)
Philippine Islands	(437)	(108,386)	(182)	(41,042)
Canada	141	29,767	129	20,105
Cuba	123	32,326	51	11,744
Europe	9,759	2,029,047	2,933	504,973
Belgium	(874)	(182,628)	(622)	(105,209)
France	(1,367)	(282,423)	.....	.....
Netherlands	(510)	(97,883)	(732)	(124,988)
Great Britain	(6,735)	(1,411,506)	(1,568)	(273,105)
Mexico	311	79,520	263	58,365
South America	2,114	436,513	1,139	240,143
Brazil	(91)	(23,854)	(2)	(762)
Colombia	(11)	(3,165)	(14)	(3,100)
Uruguay	(300)	(61,720)	(109)	(26,366)
Venezuela	(17)	(3,056)	(7)	(1,913)
Panama	574	125,547	236	62,488
Other countries	222	55,344	114	25,844
	14,901	3,195,101	5,161	993,130

Zinc oxide exported from the United States, 1917–1921.

Year.	Short tons.	Value.
1917	15,446	$3,148,898
1918	12,421	2,779,507
1919	14,703	3,059,276
1920	11,164	2,151,544
1921	2,511	426,253

Zinc oxide exported from the United States in 1920 and 1921.

[Figures in parentheses not duplicated in totals.]

Destination.	1920		1921	
	Short tons.	Value.	Short tons.	Value.
Africa	(a)	$165		
Asia	400	80,288	18	$5,486
Australia and Oceania	78	21,291	22	5,578
Philippine Islands	(31)	(8,047)	(14)	(2,905)
Canada	4,924	888,046	1,685	271,753
Cuba	127	35,592	24	7,066
Europe	4,168	741,024	480	70,617
France	(230)	(46,020)	(251)	(37,511)
Italy	(1,054)	(187,100)	(79)	(11,263)
Great Britain	(2,575)	(449,559)	(150)	(21,798)
Denmark	(63)	(13,019)		
Mexico	230	58,544	150	34,698
South America	943	240,664	109	25,143
Brazil	(559)	(139,027)	(9)	(2,527)
Panama	224	65,899	12	2,905
Other countries	70	20,031	11	3,007
	11,164	2,151,544	2,511	426,253

a Less than 1 ton.

PRICES AND VALUE.

The total amount and the average per ton received for sales of each lead and zinc pigment and salt are given in the tables on page 55. Figure 5 shows the relation of the average weekly price of lead in New York to the weekly quotations on several pigments and salts of lead as given in the Oil, Paint, and Drug Reporter, and figure 6 shows the relation of the weekly average quoted price of prime western slab zinc in St. Louis to the weekly quotations on certain pigments and salts of zinc, as given in the same journal. The qualities and conditions of the pigments and salts on which the prices were quoted are designated as follows:

Sublimed lead, "in casks."
White lead, "American, dry, in casks."
Litharge, "commercial, powdered, in casks."
Red lead, "dry, in casks."
Orange mineral, "American."
Lead acetate, "brown, broken."
Lead arsenate, "paste."
Zinc oxide, "commercially lead-free."
Lithopone, "in barrels."
Zinc chloride, "granulated."
Zinc sulphate, "industrial."

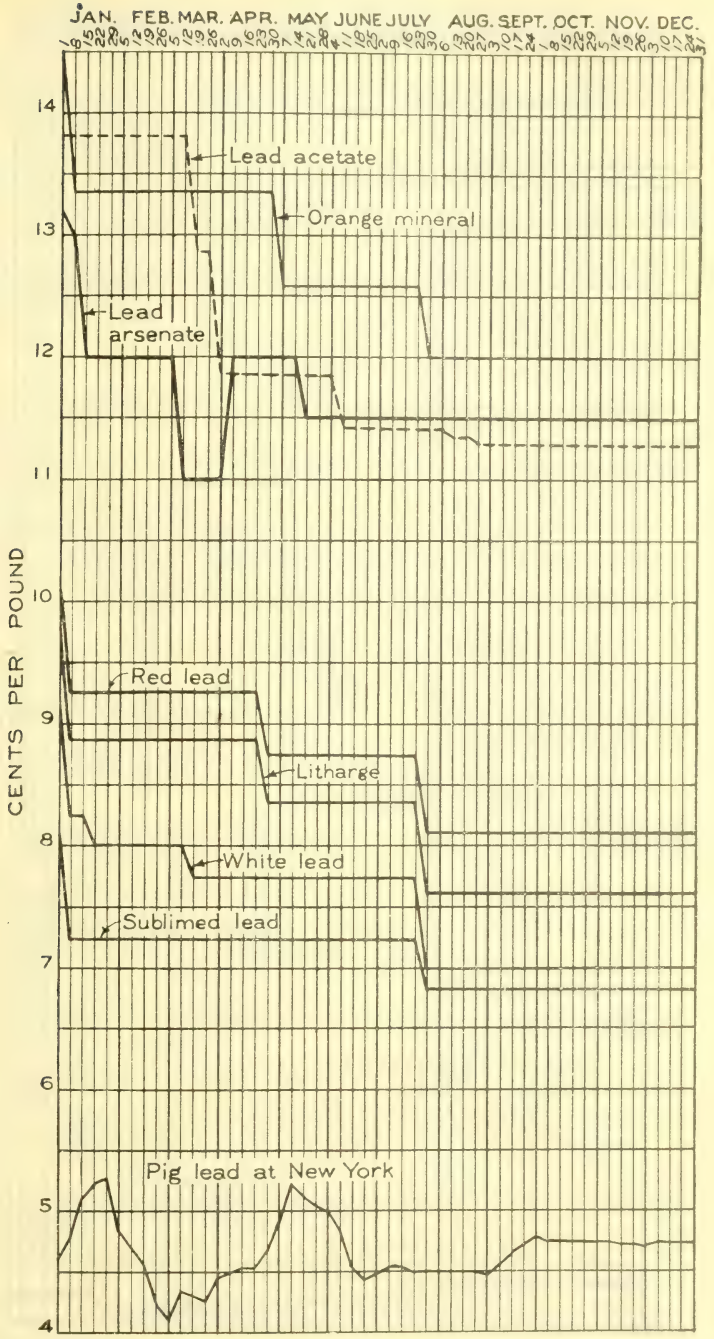

FIGURE 5.—Diagram showing relation of weekly prices of lead pigments and salts to the average weekly quoted price of lead at New York.

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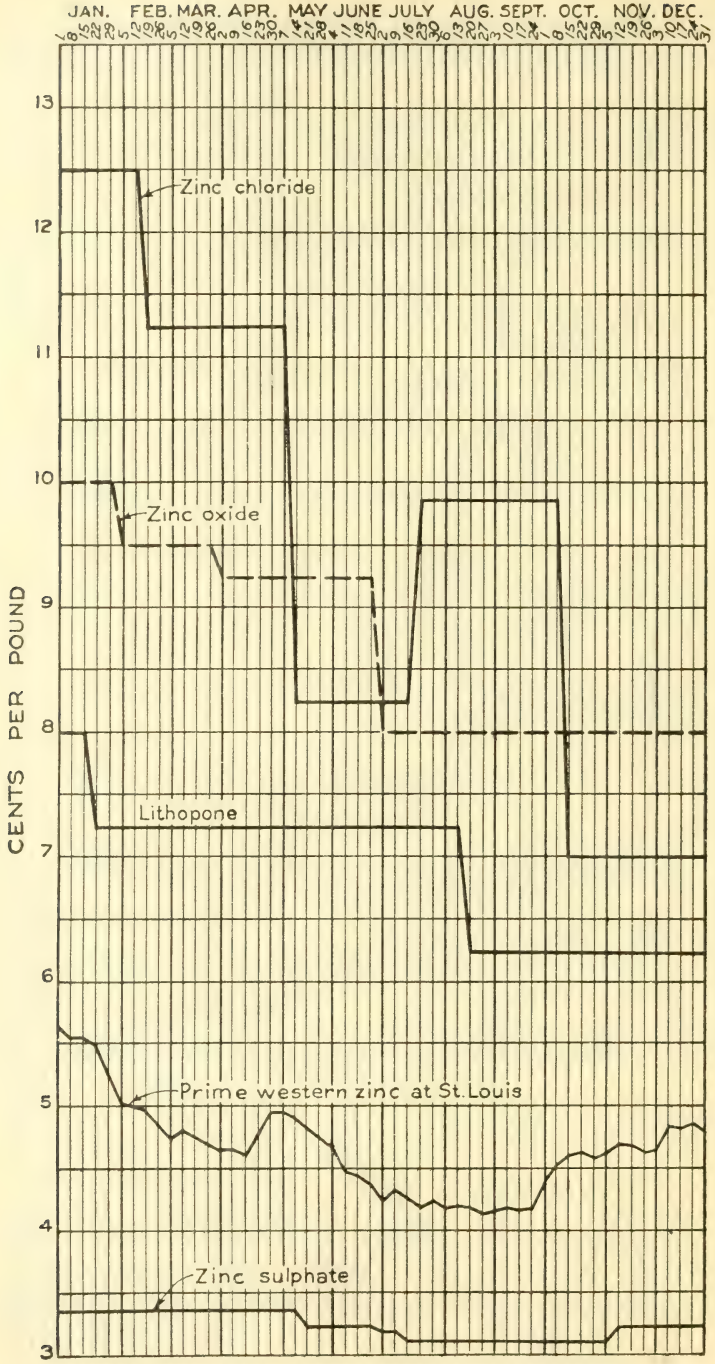

FIGURE 6.—Diagram showing relation of weekly prices of zinc pigments and salts to the average weekly quoted price of prime western zinc at St. Louis.

PRODUCERS.

Producers of lead and zinc pigments and salts, 1919–1921.

White lead:	
Anaconda Lead Products Co. (new)	East Chicago, Ind.
Carter White Lead Co	South Chicago, Ill.
E. I. du Pont de Nemours & Co	Philadelphia, Pa.
Eagle-Picher Lead Co	Cincinnati, Ohio.
Euston Process Co	Scranton, Pa.
W. P. Fuller & Co	South San Francisco, Calif.
Hammar Bros. White Lead Co	East St. Louis, Ill.
John T. Lewis & Bros. Co	Philadelphia, Pa.
Matheson Lead Co	Long Island City, N. Y.
National Lead Co	Melrose, Calif.
Do	Chicago, Ill.
Do	St. Louis, Mo.
Do	New York, N. Y.
Do	Cincinnati, Ohio.
National Lead & Oil Co. of Pennsylvania	Pittsburgh and New Kensington, Pa.
Sherwin-Williams Co	Chicago, Ill.
United Lead Co	Perth Amboy, N. J.
Wetherill & Bro	Philadelphia, Pa.
Sublimed lead:	
Eagle-Picher Lead Co	Joplin, Mo.
St. Louis Smelting & Refining Co	Collinsville, Ill.
Red lead, orange mineral, and litharge:	
Chadwick-Boston Lead Co.[1] (out of business)	Cambridge, Mass.
E. I. du Pont de Nemours & Co.[1]	Philadelphia, Pa.
Eagle-Picher Lead Co	Joplin, Mo.
Do	Newark, N. J.
Do	Cincinnati, Ohio.
W. P. Fuller & Co	South San Francisco, Calif.
Lead Products Co.[1] (out of business)	St. Louis, Mo.
John T. Lewis & Bros. Co	Philadelphia, Pa.
Matheson Lead Co	Long Island City, N. Y.
National Lead Co	Melrose, Calif.
Do	Chicago, Ill.
Do	St. Louis, Mo.
Do	New York, N. Y.
National Lead & Oil Co. of Pennsylvania	Pittsburgh and New Kensington, Pa.
Pennsylvania Smelting Co	Carnegie, Pa.
Sherwin-Williams Co	Chicago, Ill.
Wetherill & Bro	Philadelphia, Pa.
Zinc oxide and leaded zinc oxide:	
American Smelting & Refining Co.[1]	Omaha, Nebr.
American Steel & Wire Co.[1]	Donora, Pa.
American Zinc & Chemical Co	Langeloth, Pa.
American Zinc Co. of Illinois	Hillsboro, Ill.
American Zinc Oxide Co	Columbus, Ohio.
Bartlesville Zinc Co	Bartlesville, Okla.
Bertha Mineral Co.[1]	Austinville, Va.
Eagle-Picher Lead Co	Hillsboro, Ill.
Do. (new)	East St. Louis, Ill.
Empire Zinc Co.[1] (new)	Canon City, Colo.
Grasselli Chemical Co.[1]	Grasselli, Ind.
Grubnau Chemical Co., Inc	Waldo, N. Mex.
Metallurgic Products Corporation [1] (out of business)	Baltimore, Md.
Mineral Point Zinc Co.[1]	Depue, Ill.
Do	Mineral Point, Wis.
Missouri Oxide & Chemical Co	Joplin, Mo.
New Jersey Zinc Co. of Pennsylvania	Palmerton and Freemansburg, Pa.
Ohio Zinc Co.[1]	Canon City, Colo.
Ozark Smelting & Mining Co	Coffeyville, Kans.

[1] No production in 1921.

Zinc oxide and leaded zinc oxide—Continued.	
River Smelting & Refining Co	Florence, Colo.
Shasta Zinc & Copper Co. (new)	Winthrop, Calif.
Trenton Zinc & Chemical Co. (formerly M. M. S. Metal Co.)	Trenton, N. J.
U. S. Zinc Co	Pueblo, Colo.
Western Zinc Oxide Co	Leadville, Colo.
Lithopone:	
Butterworth-Judson Corporation [1] (out of business)	Newark, N. J.
Collinsville Zinc Corporation	Collinsville, Ill.
Consolidated Chemicals Products Co.[1]	Federal, Ill.
E. I. du Pont de Nemours & Co	Camden and Newark, N. J.
Do	Philadelphia, Pa.
Glidden Co. [2]	St. Helena, Md.
Grasselli Chemical Co	Grasselli, N. J.
Krebs Pigment & Chemical Co	Newport, Del.
Metals & Chemicals Extraction Corporation.	Oakland, Calif.
Midland Chemical Co	Argo, Ill.
Mineral Refining & Chemical Corporation	St. Louis, Mo.
New Jersey Zinc Co	Palmerton, Pa.
Sherwin-Williams Co	Chicago, Ill.
United Color & Pigment Co	Newark, N. J.
Zinc salts:	
American Zinc & Chemical Co	Langeloth, Pa.
Arkansas Preservative Co	Argenta, Ark.
By-Products Steel Corporation	Weirton, W. Va.
Chas. Cooper & Co	Newark, N. J.
Consolidated Chemical Products Co.[1]	Federal, Ill.
Delaware Hard Fibre Co	Wilmington, Del.
General Chemical Co	Chicago, Ill.
Grasselli Chemical Co	Grasselli, Ind.
Do	Grasselli, N. J.
Do	Cleveland, Ohio.
Great Western Electro-Chemical Co	San Francisco, Calif.
Charles Lennig & Co. (Inc.)	Philadelphia, Pa.
Merrimac Chemical Co	Everett, Mass.
Metal & Thermit Corporation [1]	Chrome, N. J.
Metallurgic Products Corporation [1] (out of business)	Baltimore, Md.
Metals & Chemicals Extraction Corporation.	Oakland, Calif.
Monsanto Chemical Works	East St. Louis, Ill.
New Jersey Zinc Co	Palmerton, Pa.
Newport Co	Milwaukee, Wis.
Pennsylvania Salt Manufacturing Co. (new).	Wyandotte, Mich.

[1] No production in 1921.
[2] Acquired from Chemical Pigments Corporation, July, 1920.

BAUXITE AND ALUMINUM.

By J. M. Hill.

BAUXITE.

DOMESTIC PRODUCTION AND CONSUMPTION.

The bauxite miners of the United States were compelled to curtail their operations in 1921, owing to the stagnation in the industries that use bauxite as a raw material. The domestic production declined 73 per cent from that of 1920 and was about one-fifth of the peak production of 1918, as shown in the following table. Production was cut about 63 per cent in the eastern fields and about 75 per cent in Arkansas. It is reported that late in 1921 there was some revival of business and that the bauxite mines were being put in shape for larger operations.

The figures for imports and exports in the following table are obtained from the records of the Department of Commerce.[1] The apparent consumption in the United States, as given in this table, is not strictly accurate, for the bauxite concentrates exported actually represent several times this quantity of crude bauxite.

Bauxite produced and consumed in the United States, 1917–1921.

Year.	Domestic production.					
	Georgia, Alabama, and Tennessee.		Arkansas.		Total.	
	Long tons.	Value.[a]	Long tons.	Value.[a]	Long tons.	Value.[a]
1917	62,134	$395,051	506,556	$2,724,007	568,690	$3,119,058
1918	42,829	314,112	562,892	3,133,880	605,721	3,447,992
1919	43,076	346,588	333,490	1,855,159	376,566	2,201,747
1920	40,029	349,453	481,279	2,897,892	521,308	3,247,345
1921	14,700	134,400	124,850	755,400	139,550	889,800

Year.	Imports.		Exports.[b]		Apparent domestic consumption.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
1917	7,691	$28,989	21,791	$1,323,926	554,590	$1,824,121
1918	3,653	14,791	19,711	1,523,688	589,663	1,939,095
1919	6,082	36,820	17,701	1,372,094	364,947	866,473
1920	42,895	251,284	22,257	1,843,596	541,946	1,655,033
1921	27,587	164,589	5,942	488,785	161,195	565,604

[a] Value f. o. b. mines.
[b] Includes bauxite concentrates.

[1] Statistics of imports and exports of both bauxite and aluminum compiled by J. A. Dorsey, of the U. S. Geological Survey.

Domestic bauxite was reported as sold to three consuming industries, as indicated in the following table. The consumption in the abrasive industry decreased 87 per cent—a direct reflection of the condition of the general manufacturing industry of the United States. The consumption in the aluminum industry decreased 76 per cent and in the chemical industry 52 per cent. About half of the imported bauxite was consumed by the chemical industry and the remainder by the makers of aluminum.

Domestic bauxite consumed by various industries, 1917–1921, in long tons.

Industry.	1917	1918	1919	1920	1921
Aluminum	375,000	419,043	272,270	383,154	91,700
Chemical	82,000	63,896	67,842	85,878	41,000
Abrasive	110,000	112,908	35,395	[a] 52,276	6,850
Refractory	2,400	9,874	1,059	.....	.....

[a] Probably includes a small quantity sold to makers of refractories.

MARKET AND PRICES.

Bauxite finds its market east of Mississippi River and is sold largely to the manufacturers of commercial chemicals, abrasives, and refractories. In the last two years some of the makers of refractories and aluminum chemicals have been using clay as a crude material, presumably mixed with bauxite in varying proportions. The clays used in place of bauxite are what might be termed "high alumina" clays, in that they carry larger quantities of aluminum oxide than kaolin. Most of such clays come from central Missouri, where diaspore-bearing clays carrying over 50 per cent of alumina are known to occur.

Dalmatian bauxite of good grade is being offered in the United States and some French bauxite was imported in 1921, athough the French export duty on bauxite apparently hindered the receipt of much material from France.

The largest consumers of bauxite in the United States are also producers, and there is a small market for what might be called "outside bauxite." Consumers who do not own deposits contract for their supplies for considerable periods, apparently with the idea of assuring themselves of an adequate supply of bauxite of the grade desired. The price of bauxite at mines or shipping point, as reported by independent producers, ranged from $8 to $12 a ton; the average price reported by all producers for the year 1921 was $6.38 a ton f. o. b. mines. Consumers, on the other hand, report prices that average $15 a ton f. o. b. plants. Part of this spread can be accounted for by freight, but some of it is without doubt due to the control of the mines by consumers.

A complete list of all users of bauxite known to the United States Geological Survey follows:

Aluminum Co. of America, Pittsburgh, Pa.
Booth Chemical Co., P. O. Box 203, Elizabeth, N. J.
Carborundum Co., Niagara Falls, N. Y.
Charles Lennig & Co. (Inc.), 112 South Front Street, Philadelphia, Pa.
Charles Taylor Sons Co., Cincinnati, Ohio.
Columbus Waterworks, R. D. 5, Columbus, Ohio.
Como Chemical Co., Kokomo, Ind.
Cumberland Waterworks, R. D. 3, Cumberland, Md.
Detroit Chemical Works, 238 Junction Avenue, Detroit, Mich.
Detroit Waterworks, Detroit, Mich.
E. I. du Pont de Nemours & Co., Wilmington, Del.
Erie Chemical Works, 31 Union Square West, New York, N. Y.
Exolon Co., 156 Sixth Street, Cambridge, Mass.
General Abrasives Co., Niagara Falls, N. Y.
General Chemical Co., 25 Broad Street, New York, N. Y.
General Refractories Co., Trinity Building, New York, N. Y.
Gulf Refining Co., Pittsburgh, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
International Abrasive Corporation, 5 Dorchester Avenue Extended, Boston, Mass.
Jarecki Chemical Co., St. Bernard Station, Cincinnati, Ohio.
Kalbfleisch Corporation, Chattanooga, Tenn.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Massillon Stone & Fire Brick Co., Massillon, Ohio.
Merrimac Chemical Co., 33 Broad Street, Boston, Mass.
Metropolitan Water District of Omaha, Omaha, Nebr.
Montclair Water Co., Paterson, N. J.
Norton Co., Worcester, Mass. (also Niagara Falls, N. Y.).
Pennsylvania Salt Manufacturing Co., Widener Building, Philadelphia, Pa.
Springfield Waterworks, Springfield, Mass.
Superior Chemical Co., Joliet, Ill.
Trenton Waterworks, Trenton, N. J.
Welch Chemical Co., 8 East Long Street, Columbus, Ohio.

In 1921 bauxite was produced by the companies listed below. It is not known whether all these producers are in position to sell bauxite, but any of them might have some surplus which could enter the general market.

American Bauxite Co., 1111 Harrison Building, Philadelphia, Pa.
E. I. du Pont de Nemours & Co., Wilmington, Del.
Globe Bauxite Co., Joliet, Ill.
Kalbfleisch Corporation, 31 Union Square West, New York, N. Y.
Norton & Co., Worcester, Mass.
Republic Mining & Manufacturing Co., 1111 Harrison Building, Philadelphia, Pa.
Warner Mining Co., Adairsville, Ga.

WORLD'S PRODUCTION.[1a]

World's production of bauxite, 1913 and 1916–1921, by countries, in metric tons.

Country.	1913	1916	1917	1918	1919	1920	1921
Austria:							
Dalmatia	(a)	83,837	b 134,781	b 94,500	(a)	(c)	(c)
Istria	(a)	58,489	b 28,341	b 70,100	(a)	(d)	(d)
British Guiana			2,070	4,266	2,008	31,883	(a)
British India	1,203	762	1,385	1,211	1,709	(a)	(a)
France	309,294	b 106,170	b 120,883	(a)	159,103	b 186,693	b 84,942
Hungary	b 1,792	(a)	b 128,651	(a)	(a)	(a)	(a)
Italy	6,952	8,887	7,789	7,800	2,972	d 13,139	d 49,100
Jugoslavia: Dalmatia	(e)	(e)	(e)	(e)	(e)	27,860	(a)
Spain				460	1,780	540	(a)
United Kingdom	6,152	10,495	14,960	9,743	9,369	11,197	(a)
United States	213,615	431,923	577,817	615,443	382,610	529,675	141,790

a Figures not yet available.
b Unofficial.
c Reported under Jugoslavia.
d Istria included under Italy.
e See Austria.

BAUXITE DEPOSITS.

DOMESTIC DEPOSITS.

Alabama.—The only producer of bauxite in Alabama was the Republic Mining & Manufacturing Co., which continued operations at Rock Run.

Arkansas.—The E. I. du Pont deposits near Little Rock, Ark., were worked for a short time in 1921, but the mines of the Republic Mining & Manufacturing Co. were closed. The American Bauxite Co. greatly curtailed its operations at Bauxite, Saline County. The Globe Bauxite Co. continued at about its normal capacity.

California.—A deposit of unknown size, carrying nodular laterite and some material which is unquestionably bauxite, was located by L. M. Richards in Riverside County, Calif. Mr. Richards has been closely associated with the bauxite industry in the East, as well as with the diaspore-mining industry in central Missouri. The Geological Survey has also received samples of clay from southern California, which carry more than 50 per cent of alumina and appear to be similar to the "high alumina" clays of Missouri.

Georgia.—Bauxite was produced in Georgia in 1921 in Sumter, Bartow, Randolph, Wilkinson, and Meriwether counties, stated in the order of their rank of production. The Republic Mining & Manufacturing Co. was the largest producer, and operated one mine each in Bartow, Meriwether, Sumter, and Wilkinson counties. The Kalbfleisch Bauxite Co. operated mines in Bartow and Randolph counties, and the Warner Mining Co. in Bartow County.

Missouri.—Although Missouri, so far as known, possesses no bauxite deposits, there are in Gasconade and Maries counties, in the central part of the State, deposits of diaspore-bearing clay carrying more than 50 per cent of alumina, which is used in the abrasive, chemical, and refractory industries in place of bauxite. Reports from a few of the larger producers show that at least 20,000 tons of this material was sold and used in 1921 at prices ranging from $1.60 to $8 a ton. The great bulk of this output was consumed by the refractory-brick industry of St. Louis and vicinity.

[1a] For more complete data see pp. 513–564.

Tennessee.—The Kalbfleisch Bauxite Co. continued operations at its bauxite mines at East Chattanooga, Tenn., and was the only producer in the State.

FOREIGN DEPOSITS.

Considerable information concerning bauxite deposits throughout the world is given in a report of the Imperial Mineral Resources Bureau,[2] of England.

Australia.—Bauxitic laterites occurring in the Darling Range of Western Australia have been described by Gibb,[3] who says that there are hundreds of thousands of tons of high-grade laterite within easy access of the railroad. The published analyses, however, with a few exceptions seem to be too high in silica and low in alumina to indicate the presence of much bauxite, though the material might be used in the chemical industry.

Saint-Smith[4] describes bauxitic laterite near Charters Towers, Queensland, as derived from the weathering of granodiorite and mentions one bed in particular that may be good bauxite.

France.—By a decree of October 20, 1920, a duty of 20 per cent ad valorem was placed on bauxite exported from France. Apparently this duty affected the bauxite-mining industry so seriously that it was repealed by a decree dated October 11, 1921. A review of the industry was published in Commerce Reports for December 19, 1921.

Hungary.—It is reported[5] that a large deposit of bauxite has been found in the Bakony district, Hungary, near the railroad between Veszprem and Deveczer, which will be developed by the Tapolcaer Mining Co., of Budapest.

Italy.—The bauxite deposits of the newly acquired Italian Provinces of Dalmatia and Istria, described in 1920,[6] have proved of considerable economic importance, and it is known that bauxite from these mines has been offered in the United States.

British Guiana.—The Demerara Bauxite Co. suspended mining operations in British Guiana during 1921, because of lack of demand for its product, though 29,394 tons of bauxite mined in 1920 was shipped to the United States. Some information concerning the bauxite of British Guiana was recently given by Emory.[7] Morrison & Sons, of London, and the British aluminum makers have organized a bauxite mining company, which is reported to have been given a concession for all the bauxite along Demerara River, British Guiana, not controlled by the Demerara Bauxite Co. This is presumably the company, whose formation was brought about by the British Government in order to control the bauxite of this colony.

Dutch Guiana.—In Surinam, Dutch Guiana, the Surinaamsche Bauxite Maatschappy has constructed a bauxite drying and dockage equipment at Moenge, 100 miles above Paramaribo, on Surinam River. All operations were suspended during 1921, owing to unsettled conditions in the bauxite industry. The bauxite deposits

[2] Aluminum and bauxite in the mineral industry of the British Empire and foreign countries, London, His Majesty's Stationery Office, 1921. Price 9d.
[3] Gibb, M. A., The bauxite deposits (aluminous laterite) of west Australia, Perth, 1919.
[4] Saint-Smith, E. C., Lateritic deposits near Charters Towers: Queensland Govt. Min. Jour., vol. 22, p. 359, 1921.
[5] Min. Jour. (London), vol. 133, p. 326, 1921.
[6] Crema, C., The bauxites of Istria and Dalmatia: La Miniera italiana, vol. 4, pp. 3–10, July-Aug., 1920.
[7] Emory, L. T., British Guiana: Eng. and Min. Jour., vol. 111, p. 363, 1921.

have been described in two articles (in Dutch), one by Douglas,[8] which is a general account of the utilization and occurrence of bauxite, with incidental mention of the Dutch deposits, and the other by Dentz,[9] which deals rather with the organization of the work than with the geology or the development of the deposits and contains some photographs of the camp and the deposits.

French Guiana.—It is reported that the Guiana Development Co. has sent a corps of engineers to develop its property on Marowine River in French Guiana.

ALUMINUM.

DOMESTIC PRODUCTION AND CONSUMPTION.

The value of the aluminum produced in the United States in 1921 was about one-fourth of that in 1920, and the value of the aluminum consumed was approximately 35 per cent of that in 1920. As is shown in the following table, the depression in all branches of the aluminum industry was very great.

Value of aluminum produced and consumed in the United States, 1917–1921.

Year.	Domestic production.[a]		Imports.[b]	Exports.[c]	Apparent consumption.
	Primary metal.	Secondary metal.			
1917	$45,882,000	$16,711,800	$56,890	$14,586,467	$48,064,200
1918	41,159,000	10,113,600	554,586	10,869,388	40,957,800
1919	38,558,000	12,014,600	4,568,595	3,890,326	51,250,900
1920	41,375,000	9,489,100	13,077,022	5,630,781	58,310,300
1921	10,906,000	3,775,400	8,889,791	3,108,857	20,462,300

[a] Value of primary metal based on average open-market price at New York, as quoted by the Engineering and Mining Journal, and that of secondary aluminum based on average price at New York as given by American Metal Market.

[b] Imports for consumption include aluminum in crude form, scrap, bars, strips, rods, plates, sheets, and all manufactures of.

[c] Exports include ingots, metal and alloy, plates and sheets, and all other manufactures of.

MARKET AND PRICES.

To judge from reports, there was an oversupply of all grades of aluminum during 1921. The quoted price of domestic metal was 28 to 28.5 cents a pound from the beginning of the year to the middle of July, when it was reduced to 24.5 to 25 cents a pound.[10] This price was maintained to the first of December and then was further reduced to 20 cents. Imported aluminum was quoted at 2 to 3 cents a pound lower than domestic aluminum of similar grades. It is to be noted that the average price for aluminum for 1921, as given by the American Metal Market, was 21.21 cents a pound.

[8] Douglas, E. A., Bauxite and its uses: Overdruk uit de Mijningenieur, 1921.

[9] Dentz, F. O., De Bauxietnijverheid en de Stichting van een Nieuwe Stad in Suriname: West-Indische Gids, Tweede Jaargang, No. 10, February, 1921.

[10] Eng. and Min. Jour., 1921.

ALUMINUM INDUSTRY.

There was no necessity for change in the domestic plants, except to limit the output, which was done. It is reported that the Aluminum Co. of America has plans for a new development of power near Long Sault Rapids, New York.

Apparently no changes in the status of the British aluminum industry took place during 1921, except for the formation of a mining company to develop deposits in British Guiana.

In France the industry suffered the same fate as in other countries. The output of aluminum ingots for the first six months of the year was 100 metric tons, as compared with 831 tons during the same period of 1920.[11]

The German aluminum works found difficulty not only in obtaining raw materials but also in competing with low prices and a very much decreased demand. Apparently the German industry has plant capacity to produce about 30,000 tons of aluminum annually.

ALUMINUM SALTS.

As will be seen from the following table, the production of aluminum chemicals decreased in 1921, as compared with 1920, though the decrease was not so great as in some of the products made from bauxite. The total quantity of aluminum chemicals made and sold during 1921 was 184,820 short tons, valued at $7,546,000. This includes, besides the products mentioned in the table, alumina and aluminum chloride, which were largely consumed in the plants themselves and not sold to outside consumers.

Alum and aluminum sulphate produced and sold in the United States and aluminum salts imported, 1917–1921.

Year.	Production.						Imports.[a]	
	Alum.			Aluminum sulphate.			Short tons.	Value.
	Short tons.	Value f. o. b. plant.		Short tons.	Value f. o. b. plant.			
		Total.	Average.		Total.	Average.		
1917	19,714	$1,017,083	$51.60	178,738	$5,746,427	$32.15	507	$39,088
1918	20,286	1,051,449	51.83	209,079	6,473,086	30.96	231	18,519
1919	17,019	879,198	51.66	200,034	6,763,063	33.80	343	21,877
1920	16,824	992,259	58.98	234,003	8,228,713	35.16	1,340	69,896
1921	12,220	755,500	61.82	165,920	6,117,200	36.87	1,009	45,963

[a] Includes alumina, aluminum hydrate or refined bauxite, alum, alum cake, aluminum sulphate, aluminous cake, and alumin crystals or ground.

Included in the alums are ammonia, potash, and sodium alum. These are combinations of the sulphates of the elements named with aluminum sulphate. In 1921 there was 6,280 short tons of ammonia alum sold by six producers at an average price of $69 a ton, and 5,910 tons of sodium alum was sold at an average price of $49 a ton. Less than 50 tons of potash alum was reported as made and sold. Five companies reported sales of 5,650 tons of aluminum chloride, valued at $552,300, or approximately $98 a ton.

[11] Commerce Repts, Dec. 12, 1921, p. 893.

Aluminum sulphate is produced in two grades, though sold under various trade names. Nineteen industrial plants reported sales of 154,920 tons of "commercial" aluminum sulphate, valued at $5,525,100, or an average of $36 a ton. Commercial aluminum sulphate to the amount of 3,060 tons was made at municipal waterworks in 1921 at an average cost of $17 a ton. Iron-free aluminum sulphate sold from six plants in 1921 amounted to 11,000 short tons, valued at $592,000.

Experiments carried on by the Department of Agriculture in 1921 seem to indicate that treatment of overirrigated lands with aluminum sulphate might put the ground in shape for further planting.

BAUXITE ABRASIVES.

The Geological Survey has not published statistics of the quantity of artificial abrasives made from bauxite for a number of years. Producers of bauxite in 1921 report that 6,850 tons of bauxite was sold to makers of abrasives, as compared with 52,276 tons in 1920. The abrasive makers curtailed their output very materially in 1921 and were probably also well stocked with bauxite from purchases in 1920.

BAUXITE REFRACTORIES.

Very little bauxite has been sold to makers of refractories for the last two or three years. Apparently the makers of aluminous refractory brick are now making their products from "high-alumina clay," some of which from central Missouri is known to be utilized by St. Louis refractory makers. Reports from some of the producers of "diaspore" and "high-alumina clay" from Gasconade and Maries counties, Mo., indicate that at least 20,000 tons of this material was used by the refractory industry in 1921.

TIN.

By Bertrand Leroy Johnson.

PRODUCTION AND DEVELOPMENT.

Tin mining was in progress in the United States in 1921 only in Alaska and South Dakota. Tin-bearing concentrates were obtained only from the Alaskan operations.

Tin mined in the United States (including Alaska), 1915–1921, in short tons.

[Metallic tin estimated as obtainable from concentrates produced in tin-mining operations.]

1915	102	1919	56
1916	140	1920	22
1917	110	1921	4
1918	69		

Alaska.[1]—Tin mining almost ceased in Alaska in 1921. No operations were in progress in the York district of Seward Peninsula, hitherto the principal source of Alaska tin, and the small output of Alaskan tin-bearing concentrate (7 short tons) came chiefly from the Hot Springs district of the Tanana region, where it was recovered incidentally to gold-placer mining. The recoverable content of the metallic tin in the concentrate produced is estimated to be 4 short tons. None of the concentrate produced during the year was shipped.

South Dakota.—The National Tin Corporation is reported to have done 700 feet of underground development work on its property near Hill City, S. Dak., during the year, consisting of 200 feet of drifts and 500 feet of crosscuts. No ore was mined during the year. On the Frederic tin property, at Keystone, S. Dak., only development work, consisting of open cuts and prospect shafts on eight claims, is reported as having been done in 1921.

SMELTING INDUSTRY.

Five tin-smelting plants in operation in the United States produced 11,542 short tons of metallic tin in 1921, almost wholly from Bolivian concentrate. The producing smelters were those of the American Smelting & Refining Co., Perth Amboy, N. J.; the Williams Harvey Corporation, Brooklyn, N. Y.; the Andes Electin Co., South Brooklyn, N. Y.; Richards & Co., Malden, Mass.; and the Seaboard Metal Corporation, Arlington, N. J. The smelting of imported tin-bearing concentrate in the United States was begun in 1916.

Smelter output of metallic tin in the United States, 1916–1921, in short tons.

1916	2,261	1919	12,236
1917	6,065	1920	17,652
1918	10,284	1921	11,542

[1] Data regarding the Alaska tin-mining industry were obtained from Brooks, A. H., The Alaskan mining industry in 1921: U. S. Geol. Survey Bull. 739–A, 1922.

IMPORTS AND EXPORTS.[2]

Tin concentrate imported into the United States, 1915–1921.

[General imports.]

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1915	552	$182,950	1919	19,196	$11,871,948
1916	8,040	4,032,460	1920	34,148	18,795,162
1917	9,054	4,743,099	1921	15,340	5,672,861
1918	18,394	11,444,401			

Tin imported as metal and entered for consumption in the United States, 1915–1921.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1915	57,792	$38,736,909	1919	44,849	$50,890,019
1916	69,035	51,802,232	1920	62,795	73,440,872
1917	72,166	63,860,340	1921	27,101	16,645,719
1918	71,254	93,144,218			

The details of the general imports of tin concentrate and metallic tin for 1921 are given in the following table. The real origin of the concentrate and metal is not disclosed by this table, for it indicates only the countries from which the shipments were made direct to the United States. Many of the figures represent reexports, the concentrates credited as exported from Chile and Peru coming originally in all probability from the tin mines of Bolivia.

Tin concentrate and metallic tin imported into the United States in 1921.

[General imports.]

Country.	Tin concentrate.		Metallic tin as bars, blocks, grains, and granulated.	
	Short tons.	Value.	Short tons.	Value.
Belgium			1	$757
France			56	46,714
Germany			(20 lbs.).	9
Portugal			1	712
England			7,829	4,779,569
Canada	24	$8,535	7	4,803
Costa Rica			39	10,500
Panama		190		
Argentina			77	40,174
Bolivia	4,758	1,884,399		
Brazil			59	28,819
Chile	10,446	3,748,731		
Peru	112	31,006		
Uruguay			162	93,454
China			28	14,840
British India			22	11,207
Straits Settlements			17,394	10,746,614
Dutch East Indies			112	54,386
Hongkong			992	619,297
Japan			5	5,604
Australia			317	188,260
	15,340	5,672,861	27,101	16,645,719

[2] Statistics of imports and exports compiled from the records of the Bureau of Foreign and Domestic Commerce.

Exports of tin ore are insignificant and are not recorded. Domestic exports of metallic tin (imported as ore and exported as pigs, bars, etc.) amounted to 306 short tons in 1919, 706 short tons in 1920, and 1,154 short tons in 1921. Foreign exports of metallic tin (imported as pigs, bars, etc., and exported as such) were 76 short tons in 1919, 333 short tons in 1920, and 406 short tons in 1921.

CONSUMPTION.

The quantity of new (primary) tin made available for consumption in the United States during any given year may be obtained by adding the general imports of metallic tin to the quantity of tin produced in the United States and subtracting from the result the sum of the domestic and foreign exports of metallic tin. The following table gives this information for 1921:

New tin made available for consumption in the United States in 1921, in short tons.

Metallic tin imported into the United States (general imports)	27,101	
Tin produced by smelters in the United States from foreign ore	11,542	
		38,643
Domestic tin exported	1,154	
Foreign tin reexported	406	
		1,560
		37,083

The quantity of this new tin actually consumed in the United States during 1921 is not susceptible of accurate determination, as a close estimate of this annual consumption is not possible without a knowledge of the stocks in various hands in this country.

PRICES.

The average price of Straits tin in New York in 1921 was 30 cents a pound, as compared with 50.36 cents in 1920.[3] The course of the market during the year is shown in the following table:

Average monthly prices, in cents per pound, of Straits tin in New York in 1921.[3]

January	36.11	May	32.52	September	26.73
February	32.47	June	29.57	October	27.74
March	28.85	July	27.69	November	29.02
April	30.41	August	26.40	December	32.49

The average price for the year in London was £165 8s. 2d. a ton of 2,240 pounds. The lowest price was £148 and the highest price was £210½.[4]

[3] Metal Statistics, 1922, p. 327.

[4] Idem, p. 333.

SILVER, COPPER, LEAD, AND ZINC IN THE CENTRAL STATES.[1]

(MINES REPORT.)

By J. P. Dunlop and F. Begeman.

INTRODUCTION.

The silver, copper, lead, and zinc mines of the Central States are in Arkansas, Illinois, Kansas, Kentucky, Michigan, Missouri, Oklahoma, and Wisconsin. The territory thus embraced lies in the great interior valley province of the United States, which extends from the Appalachian system to the Rocky Mountain front, exclusive of the Black Hills. Most of the mines are in the Paleozoic sedimentary rocks of this province, but the copper range of northern Michigan comprises lavas and intercalated sediments of pre-Cambrian age.

In the lead and zinc regions of the Central States the material sold is principally concentrates,[2] and payment is made according to a basic price for concentrates of a certain quality. The details of this method are given in the pages devoted to Missouri in this report for 1914. The figures reported to the Geological Survey by producers represent the quantity and assay content of concentrates sold and the amount received in payment. The total metal produced is calculated from the first two of these items.

The operators in Michigan report the quantity of concentrates produced and the actual recovery of copper from concentrates smelted.

In any year the mines may produce more or less concentrates than are smelted during the same period. The copper content of concentrates produced but not smelted during the year has been estimated on the basis of the average copper recovery per ton for the year of the company producing it.

TENOR OF LEAD AND ZINC ORES OF THE CENTRAL STATES.

Much of the ore mined in the Western States is crude smelting ore—that is, it can be smelted directly without preliminary concentration. All but a very small portion of the ore from the Central States, however, is of such tenor that it requires concentration. The only fair basis for comparison of the relative magnitude of mining operations in different States is that of quantity of crude ore, or "dirt." In Kentucky and southern Illinois the lead and zinc con-

[1] A bibliography is given in Mineral Resources for 1919 and some preceding volumes.

[2] In local usage the ore as mined is called "dirt" and the concentrates are classed as "ore." Where the capacity of a concentrating plant is given, such capacity is to be understood as based on a 10-hour shift unless otherwise stated.

centrates are recovered as by-products in the concentration of the fluorspar which they accompany, and it was not possible to make calculations of the metal content of the crude ore raised.

Quantity and tenor of copper, lead, and zinc ores of Central States, 1919–1921.

State.	1919		1920		1921	
	Crude ore.	Metal content.[a]	Crude ore.	Metal content.[a]	Crude ore.	Metal content.[a]
	Short tons.	*Per cent.*	*Short tons.*	*Per cent.*	*Short tons.*	*Per cent.*
Arkansas	5,800	4.20	9,800	3.81	(b)	.....
Illinois (northern)	404,000	2.47	312,000	2.13	81,400	4.10
Kansas	1,391,600	4.61	1,704,700	4.96	1,132,000	5.26
Michigan	7,690,253	1.10	5,938,967	1.18	3,610,648	1.19
Missouri	[c] 5,690,730	3.49	6,108,030	3.15	5,302,100	3.69
Oklahoma	6,168,200	3.76	6,943,100	4.46	2,969,500	5.97
Wisconsin	1,826,200	2.95	1,742,000	2.08	136,300	3.78
	23,176,783	.....	22,758,597	.....	13,231,948	.....

[a] The percentages given in this column represent the metal content of the ore in so far as it is recovered in the concentrates. In Michigan the metal so recovered is copper, in the other Central States the metals are lead and zinc, the relative proportions of which are shown in the table on another page and in the tables of tenor of ore given in the sections devoted to the respective States.

[b] No record of ore treated.

[c] 57,000 tons of cobalt-nickel-copper ore excluded.

The marked decrease in 1921 shown by this table was distributed mainly among the copper mines of Michigan and the lead and zinc mines of Oklahoma and Wisconsin. Smaller decreases in output of lead and zinc ores occurred in Kansas, Illinois, and Missouri, although the output of disseminated lead ore in southeastern Missouri increased 255,170 tons.

The low average tenor of the crude ore mined in the Central States in 1921 is best shown by the fact that the average value of the total recoverable metal content was only $3.84 a ton of crude ore treated, $1.62 less than in 1920, owing to the low price of lead and zinc. The 9,621,300 tons of zinc, lead, and lead-zinc ores treated in the Central States in 1921 yielded lead and zinc concentrates which sold for $23,395,431, so that the mine operators realized an average of $2.43 a ton of ore mined and treated, against $3.50 a ton in 1920. The quantity and the value of zinc concentrates and also the value of lead concentrates and of both metals were much less in 1921 than in 1920.

PRODUCTION.

GENERAL STATISTICS.

The total value of the mine production of silver, copper, lead, and zinc in the Central States in 1921 was $73,500,000 less than the value for 1920. The total value of the mine production of these metals for the years 1907 to 1921, inclusive, was $1,421,837,799—$551,846,978 for copper, $513,754,874 for zinc, $350,695,922 for lead, and $5,540,025 for silver. Only in 1915, 1916, 1919, 1920, and 1921 has the value of the recoverable zinc exceeded that of the copper, and in 1921 the value of the lead was nearly double that of copper.

Mine production of silver, copper, lead, and zinc in the Central States in 1921, by States.

State.	Silver.		Copper.	
	Fine ounces.	Value.	Pounds.	Value.
Illinois	1,345	$1,345		
Michigan	310,727	310,727	86,370,028	$11,141,734
Missouri	69,902	69,902	137,591	17,749
Total, 1920	381,974	381,974	86,507,619	11,159,483
	589,510	642,566	156,207,612	28,742,200

State.	Lead.		Zinc.		Total value.
	Short tons.	Value.	Short tons.	Value.	
Arkansas	21	$1,890	15	$1,500	$3,390
Illinois	672	60,480	2,426	242,600	304,425
Kansas	18,679	1,681,110	36,994	3,699,400	5,380,510
Kentucky	69	6,210	220	22,000	28,210
Michigan					11,452,461
Missouri	180,085	16,207,650	10,845	1,084,500	17,379,801
Oklahoma	41,552	3,739,680	121,372	12,137,200	15,876,880
Wisconsin	972	87,480	3,390	339,000	426,480
Total, 1920	242,050	21,784,500	175,262	17,526,200	50,852,157
	251,816	40,290,560	337,652	54,699,624	124,374,950

Silver.—Nearly all the silver that has been produced in the Central States was recovered incidentally in the production of other metals. The output in 1921 from the copper lodes of Michigan showed a decrease of 159,462 ounces. About 16 per cent of the concentrates from lead ores mined in southeastern Missouri was desilverized and yielded most of the silver from that State recovered in 1921.

The lead-zinc-fluorspar deposits of the Kentucky-Illinois field also carry silver, and the silver recovered from the lead concentrates from Illinois was 1,345 ounces, a decrease of 6,848 ounces.

Copper.—The mine production of copper in the Central States in 1921 came from Michigan and Missouri. Michigan, which, as in other years, contributed nearly the entire output, produced 68,325,045 pounds less than in 1920. The copper produced in Missouri was derived entirely from lead ores. The total mine production of copper from Michigan and Missouri in 1921 was about 187,600,000 pounds less than in 1916.

Lead.—The mine production of lead in the Central States in 1921 showed a decrease of about 4 per cent. Missouri produced 74 per cent of the yield, against 65.6 per cent in 1920, and the recoverable lead content of galena and lead carbonate concentrates mined in Missouri equaled 45 per cent of the refined primary lead recovered in the United States from domestic ore. Of the total output of lead in Missouri the disseminated-lead district of southeastern Missouri produced 178,593 tons, again exceeding the Coeur d'Alene district of Idaho and retaining first place in the production of lead in the United States. Small shallow lead mines and barytes mines in southeastern Missouri reported the recovery of 142 tons of lead. Southwestern Missouri had an output of 1,350 tons, or 2,506 tons less than in 1920. The production in Oklahoma decreased from 65 394 tons in 1920 to 41,552 tons in 1921.

The production from Kansas mines increased from 16,788 tons in 1920 to 18,679 tons in 1921; Illinois decreased from 1,743 to 672 tons, and Wisconsin from 2,647 to 972 tons. The total production of lead from mines in the southern Illinois-Kentucky region, Arkansas, and the upper Mississippi Valley amounted to less than 1 per cent of the output of the Central States.

Zinc.—The figures showing production of zinc in the Central States in 1921 are based on mine returns, with a deduction for separating and smelting losses. The production of zinc in the Central States was about 88 per cent of the total output of primary zinc from domestic ores in the United States, against 75 per cent in 1920.

Oklahoma produced about 110,000 tons more zinc than Missouri. For many years, until 1917, Missouri had been the largest producer of zinc in the United States, but the output has decreased from 132,918 tons in 1917 to 10,845 tons in 1921. Arkansas decreased in output from 329 to 15 tons; Kentucky increased from 9 to 220 tons; northern Illinois decreased from 4,720 to 2,426 tons. No production of lead or zinc was reported from Iowa mines in 1921.

PRODUCTION OF LEAD AND ZINC, BY REGIONS.

The productive lead and zinc territory in the Central States naturally falls into seven regions, three of which are not limited to a single State. For statistical purposes the tables showing the production of lead and zinc by States are necessary, but for practical purposes it is desirable to show the production by the natural regions irrespective of State lines.

The seven regions are, in order of size of output, (1) the Joplin region, comprising southwestern Missouri, southeastern Kansas, and northeastern Oklahoma; (2) southeastern Missouri, containing the great deposits of disseminated lead; (3) the upper Mississippi Valley region, including all the lead and zinc mines in southwestern Wisconsin, Iowa, and northwestern Illinois; (4) the fluorspar region in southern Illinois and northern Kentucky; (5) northern Arkansas; (6) central Missouri; (7) the Arbuckle Mountain region, in southern Oklahoma.

The southeastern Missouri region produced about 74 per cent of the lead output of the Central States and about 45 per cent of the primary lead recovered from domestic ore smelted or refined in the United States in 1921. The Joplin region alone produced about 25 per cent of the lead and 96 per cent of the zinc of the Central States in 1921 and was much the largest producer of zinc in the United States, yielding about 85 per cent of the total zinc production from domestic ores, as against 67.8 per cent in 1920.

The lower zinc content of the zinc concentrates produced at mines in the upper Mississippi Valley region is clearly indicated by the fact that, although these mines yielded about 7.2 per cent of the total output of raw zinc concentrates of all classes, the recoverable zinc content of such concentrates was only 3.3 per cent of the recoverable zinc from mines in the Central States.

The lead content of the galena concentrates shipped from the upper Mississippi Valley region averaged 76 per cent, that of the concentrates from the Joplin region averaged about 81 per cent, and that of the concentrates from the southeastern Missouri region averaged

65 per cent. A very small proportion of the galena shipped from the Joplin region contained less than 76 per cent of lead, and some of the galena shipped contained more than 83 per cent. A large part of the sphalerite shipped from the Joplin region contained nearly 60 per cent of zinc, and the 33,803 tons shipped from the Waco district, in that region, averaged about 62 per cent.

Mine production of lead and zinc in the Central States in 1921, by regions.

Region.	Lead.[a]		Zinc.[b]		Total value.
	Short tons.	Value.	Short tons.	Value.	
CONCENTRATES.					
Joplin	76,679	$4,052,907	313,569	$7,226,570	$11,279,477
Southeastern Missouri [c]	280,358	11,737,400			11,737,400
Upper Mississippi Valley [d]	2,002	103,877	24,245	238,202	342,079
Kentucky-southern Illinois	281	14,585	621	19,800	34,385
Northern Arkansas	27	1,510	42	580	2,090
Total, 1920	359,347	15,910,279	338,477	7,485,152	23,395,431
	355,538	30,489,146	692,512	28,394,581	58,883,727
METAL.					
Joplin	61,581	5,542,290	169,211	16,921,100	22,463,390
Southeastern Missouri [c]	178,735	16,086,150			16,086,150
Upper Mississippi Valley [d]	1,506	135,540	5,816	581,600	717,140
Kentucky-southern Illinois	207	18,630	220	22,000	40,630
Northern Arkansas	21	1,890	15	1,500	3,390
Total, 1920	242,050	21,784,500	175,262	17,526,200	39,310,700
	251,816	40,290,560	337,652	54,699,624	94,990,184

[a] Includes both galena and lead carbonate concentrates.
[b] Includes sphalerite, zinc carbonate, and zinc silicate concentrates.
[c] Includes a small production from the central Missouri region.
[d] Includes Iowa, northern Illinois, and Wisconsin.

Mineral Resources for 1914 contains brief reviews of the history of lead and zinc mining in the Central States, the yearly production of each State for the period 1907 to 1914, inclusive, and historical notes and estimates of the total production of lead and zinc in each State before 1907.

ARKANSAS.

By J. P. Dunlop.

The value of the recoverable lead and zinc from Arkansas mines, which was $1,430,668 in 1917, was only $3,390 in 1921. The decrease in shipments was caused entirely by the lower price of zinc concentrates and lack of demand for them.

The production of galena in Arkansas is small compared with that in other regions. The shipments of zinc carbonate and zinc silicate concentrates, 42 tons, were less than 1 per cent of the shipments in 1917.

Mine production of lead and zinc in Arkansas, 1907–1921.[a]

Year.	Ores.						Metal content.			
	Lead concentrates (galena).		Zinc concentrates.				Lead.		Zinc.	
			Sphalerite.		Silicate and carbonate.					
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1907–1915..	416	$22,348	8,576	$315,910	12,221	$506,842	331	$29,394	8,290	$1,365,538
1916.....	339	28,097	1,670	112,726	16,609	940,224	272	37,536	6,815	1,826,420
1917.....	474	47,593	916	57,824	17,053	650,585	382	65,704	6,691	1,364,964
1918.....	155	13,594	310	16,450	2,156	68,333	120	17,040	951	173,082
1919.....	35	2,400	.....	.....	510	18,170	28	2,968	189	27,594
1920.....	10	755	.....	.....	917	28,925	8	1,280	329	53,298
1921.....	27	1,510	.....	.....	42	580	21	1,890	15	1,500

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc in 1921. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price of all grades.

Tenor of lead and zinc ore and concentrates produced in Arkansas in 1920 and 1921.

	1920	1921 [a]
Total crude ore.....short tons..	9,800	.....
Total concentrates in crude ore:		
Lead.....per cent..	0.11	.....
Zinc.....do....	9.36	.....
Metal content of crude ore:		
Lead.....do....	.08	.....
Zinc.....do....	3.73	.....
Average lead content of galena concentrates.....do....	80.0	77.7
Average zinc content of zinc silicate and carbonate.....do....	39.9	40.0
Average value per ton:		
Galena concentrates.....	$75.50	$55.93
Zinc silicate and carbonate.....	$31.54	$13.81

[a] The quantity of ore mined was very small and none of it was milled, so that no calculations as to tenor are available; ore sold was hand cobbed.

The mines are principally in Boone and Marion counties and the adjoining portions of Searcy and Newton counties, though there are also numerous mines and prospects in Baxter, Izard, Sharp, Lawrence, and other counties to the east, and deposits have been worked in Washington and Sevier counties, on the extreme western border of the State.

The ores are galena, sphalerite, and smithsonite, and the concentrates produced are generally of high grade and free or nearly free from iron or lime. The sphalerite and smithsonite are shown by analysis to contain appreciable quantities of cadmium, especially in a yellow variety of smithsonite known locally as "turkey fat," which shows as much as 0.8 per cent of cadmium.

Few of the lead and zinc mines in Arkansas were operated in 1920 and 1921, and none of those from which concentrates were shipped were operated steadily. Most of the mines have inexpensive equipment, no water to pump, and no leases requiring steady operation, so that work could be suspended until better prices were offered for zinc ores.

Mines on the Earl land, near Zinc, in Boone County, produced all the zinc concentrates shipped in 1921, and mines on the Brewer land, at Ponca, in Newton County, produced nearly all the galena concentrates.

A new hand jig plant was installed at the J. E. Nischwitz prospect, near Flippin, Marion County, but no ore was cleaned.

The mines at Rush, which were large producers in 1917, shipped no zinc carbonate in 1921. Among the active properties were the Monte Cristo mine, at Rush, and the Sure Pop No. 2, on Water Creek, which recovered some zinc that was not sold.

In addition to carbonate concentrates in stock at Zinc at the end of 1921 there were accumulations of carbonate ore at the Bald Hill, Spear, and Big Joe mines and at shipping points for the small prospects on Cow Creek in Marion County.

ILLINOIS.

By J. P. Dunlop

PRODUCTION.

Mine production of lead and zinc in Illinois in 1921, by districts.[b]

District.	Ores.				Metal content.			
	Lead concentrates (galena).		Zinc concentrates (sphalerite).		Lead.		Zinc.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Northern Illinois	700	$37,690	7,795	$97,992	534	$48,060	2,426	$242,600
Southern Illinois	181	10,892	.....	.....	138	12,420	.....	.....
	881	48,582	7,795	97,992	672	60,480	2,426	242,600
Total, 1920	2,330	206,829	17,984	396,251	1,743	278,880	4,720	764,640

[a] Mineral Resources for 1914 contains a historical review of lead and zinc mining in Illinois.

[b] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc in 1921. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price of all grades.

Tenor of lead and zinc ore and concentrates produced in Illinois, 1920 and 1921.

	1920	1921
NORTHERN ILLINOIS.		
Total crude ore, short tons	312,000	81,400
Total concentrates in crude ore:		
Lead, per cent	.35	.85
Zinc, do	5.77	9.46
Metal content of crude ore:		
Lead, do	.26	.66
Zinc, do	1.87	3.44
Average lead content of galena concentrates, do	74.8	77.8
Average zinc content of sphalerite concentrates, do	32.4	36.4
Average value per ton:		
Galena concentrates	$81.21	$53.84
Sphalerite concentrates	$22.03	$12.57
SOUTHERN ILLINOIS.		
Average lead content of galena concentrates, per cent	74.7	78.0
Average value per ton of galena concentrates	$95.27	$60.18

Mine production of silver in southern Illinois, 1907–1921.

Year.	Silver.		Lead concentrates, silver bearing.		Year.	Silver.		Lead concentrates, silver bearing.	
	Fine ounces.	Value.	Short tons.	Ounces of silver per ton.		Fine ounces.	Value.	Short tons.	Ounces of silver per ton.
1907–1915.	25,220	$14,371	4,199	6.00	1919.....	4,440	$4,973	715	6.16
1916.....	5,684	3,740	874	6.50	1920.....	8,193	8,930	1,252	6.55
1917.....	7,186	5,921	1,239	5.80	1921.....	1,345	1,345	181	7.43
1918.....	8,171	8,171	1,228	6.65					

The value of the mine production of silver, lead, and zinc in Illinois in 1921 was $304,425, as compared with $1,052,450 in 1920.

The lead and zinc deposits of Illinois fall into two distinct regions marked by different mineral association and structural environment. Those of southern Illinois belong to the Kentucky-Illinois fluorspar district; those of northern Illinois belong to the upper Mississippi Valley region.

NORTHERN ILLINOIS.

The lead and zinc mines of northern Illinois are all in Jo Daviess County, the extreme northwestern county of the State. The ores are galena, smithsonite, and sphalerite, though the first two are much less common now than formerly, when the deposits worked were mostly shallow and above water level.

Although the lead output of northern Illinois, Wisconsin, and Iowa has been large in the past, and the ores have been smelted near the mines,[3] the output in recent years has been comparatively small, and no ores have been smelted in those States.[4] The galena is practically nonargentiferous, and the zinc ores are not known to contain cadmium. Marcasite is very commonly associated with the ores, generally in such quantity as to necessitate roasting and magnetic separation.

The entire output of northern Illinois is included under the Galena district, which comprises the mines from the vicinity of Fever River to the Wisconsin State line.

The marked decreases in production of crude ore and concentrates are shown in the accompanying tables. The percentages of both lead and zinc concentrates recovered, however, increased, as did also the percentages of metal contents in the concentrates.

The largest quantity of lead and zinc concentrates in northern Illinois was derived from the North Unity mine of the Vinegar Hill Zinc Co., and galena concentrates were shipped from the Black Jack mine, which was closed early in the year. Some prospect work was done by Gus E. Brown on the Barnes land, and a number of miners out of regular employment were prospecting for galena. The North Unity was the only property operated all the year.

[3] Cox, G. H., Lead and zinc deposits of northwestern Illinois: Illinois Geol. Survey Bull. 21, p. 14, 1914.
[4] Pulsifer, H. B., History of lead smelting in Wisconsin: Min. and Eng. World, May 2, 1914, p. 821.

SOUTHERN ILLINOIS.

The lead and zinc deposits of southern Illinois are found in Pope and Hardin counties in rocks of Mississippian age in the northern extension of the Kentucky-Illinois fluorspar district. The principal product of the mines in recent years has been fluorspar, and the yield of galena is small compared with the output from other districts in the Central States.

The total production of galena concentrates for southern Illinois from 1906 to 1921 has been 9,891 tons, most of which has been shipped from the Fairview and Rosiclare mines. The shipments of zinc ores from the district have been comparatively small and scattered. The only recorded shipments of zinc carbonate, aggregating 103 tons, were made from the Empire mine in 1903 or 1904 and from four companies in 1916.

Formerly large bodies of galena near the surface were worked, but galena is now produced incidentally in the concentration of the fluorspar. For this reason it would be misleading to give the quantity of crude ore. The galena of southern Illinois is notably argentiferous as compared with the rest of the Mississippi Valley ores, and the silver content averaged for the last seven years from 5 to 7.5 ounces to the ton of lead concentrate.

Sphalerite, or zinc blende, occurs much less plentifully than galena. It is recovered as zinc middlings in the concentration of the fluorspar. The difficulty of making a clean separation of the zinc middlings has kept down the production of zinc. None has been sold from southern Illinois in the last 12 years, but there is considerable zinc ore stocked at mines which will be milled when prices for zinc are higher.

The shipments of galena concentrates decreased from 1,252 tons in 1920 to 181 tons in 1921, and the silver recovered in treating the concentrates decreased from 8,193 to 1,345 ounces.

The Fairview Fluorspar & Lead Co., by far the largest producer of galena in Illinois, operated on the Good Hope vein, which was first developed in 1862. Three shafts were operated at the 300-foot level in 1921. The old concentrating plant, which has a capacity of about 20 tons an hour, was operated until February, when the mine was closed and a new experimental mill was built, designed to treat the zinc ore which occurs in the mine workings and of which there is a considerable quantity on the dump.

The Rosiclare Lead & Fluorspar Mining Co. operates on an ore body that is probably continuous with that of the Fairview. The mill, designed to handle 500 tons a day and provided with special facilities for saving the lead and zinc both by jigs and by tables, was idle most of the year. The Hillside Fluorspar Co. opened a new mine and constructed a concentrating plant near Rosiclare, which was not operated in 1921.

IOWA.

By J. P. Dunlop.

The lead and zinc deposits of Iowa extend along Mississippi River for nearly 80 miles, in Dubuque, Clayton, and Allamakee counties. No shipments of lead or zinc concentrates from mines in Iowa were reported in 1919, 1920, or 1921.

KANSAS.

By J. P. Dunlop.

Mine production of lead and zinc in Kansas, 1921, by districts.[a]

District.	Ores.				Metal content.			
	Lead concentrates (galena).		Zinc concentrates (sphalerite).		Lead.		Zinc.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Badger-Peacock and Lawton	164	$8,137	162	$4,312	124	$11,160	84	$8,400
Waco (in Kansas)	152	6,895	15,526	386,123	116	10,440	8,659	865,900
Blue Mound-Baxter Springs	22,346	1,208,035	52,762	1,194,616	18,426	1,658,340	28,251	2,825,100
Galena	17	850	.....	.....	13	1,170	.....	.....
Total, 1920	22,679	1,223,917	68,450	1,585,051	18,679	1,681,110	36,994	3,699,400
	20,831	2,005,517	113,148	5,154,572	16,788	2,686,080	61,073	9,893,826

[a] In calculating the metal content of the ores from assays, allowance has been made for smelting losses of both lead and zinc in 1921. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in Kansas, 1920 and 1921.

	1920	1921
Total crude ore.....short tons..	1,704,700	1,132,000
Total concentrates in crude ore:		
Lead.....per cent..	1.22	2.00
Zinc.....do....	6.63	6.05
Metal content of crude ore:		
Lead.....do....	.98	1.63
Zinc.....do....	3.98	3.63
Average lead content of galena concentrates.....do....	80.6	81.6
Average zinc content of sphalerite concentrates.....do....	60.0	60.1
Average value per ton:		
Galena concentrates	$96.27	$53.79
Sphalerite concentrates	$45.36	$23.16

The lead and zinc deposits of Kansas, so far as developed, are limited to Cherokee County, in the southeastern part of the State. They form the western extension of the ore deposits of the Joplin region and display the general characteristics shown in that region, except that here typical sheet-ground deposits have not been extensively developed.

It is difficult to ascertain the production for early years or to segregate the Kansas ores from those produced in the Missouri portion of the Joplin region. If to the figures for 1886 to 1903, published by the Kansas Geological Survey,[5] are added those for 1904 to 1921, published by the United States Geological Survey, a total of 1,409,780 tons of zinc concentrates and of 219,985 tons of lead concentrates is shown as the approximate production of Kansas for 1886 to 1921.

The older mining camps at Lawton and Badger produced much less zinc and lead in 1921 than in 1920, and nearly all the production from Kansas came from the Blue Mound-Baxter district, an extension of

[5] Haworth, Erasmus, and others, History, geography, geology, and metallurgy of Galena-Joplin lead and zinc: Kansas Univ. Geol. Survey, vol. 8, 1904.

the Miami field, and the new Waco camp on the Kansas-Missouri State line.

The increase in percentage of lead concentrates in crude ore milled was due to the larger recoveries of lead from the new mines near Blue Mound, whose mills treated about 80 per cent of all the crude ore mined in Kansas.

The increase in zinc content of the sphalerite concentrates shipped was due to the much richer ore mined in the new Waco and Blue Mound districts and to lower ore prices and high costs of mining.

Badger-Peacock district.—The production of the Badger-Peacock district, including several shipments of galena from the Pershing mine, at Pershing, west of Badger, was 164 tons of galena and 162 tons of sphalerite, against 723 tons of galena and 1,884 tons of sphalerite in 1920. The Hard Rock mine shipped sphalerite early in 1921, and lessees of the Connor land and Stephen land, including Bentley & Cox and C. D. Fletcher, shipped considerable lead and a few tons of sphalerite.

Lawton-Waco district.—Nearly all the output of the Lawton-Waco district came from the mines near Waco, as the one producing property at Lawton—that of the Eastern Lead & Zinc Co.—was idle all of 1921 and sold only a small clean-up. The total production of the district (including only mines in Kansas) was 15,526 tons of sphalerite and 152 tons of galena, as compared with 15,777 tons of sphalerite in 1920. The total output of the Waco district, lying partly in Missouri and partly in Kansas, was 33,803 tons of sphalerite and 297 tons of galena against 36,857 tons of sphalerite and 290 tons of galena in 1920. The principal producing properties in the Kansas part of the Waco district were the Butte Kansas No. 2, which was operated part of the year by H. Neff, and the Barnsdall Zinc Mining Co. No. 3, which was the largest producer.

Galena district.—The production of lead concentrates in the Galena district was 17 tons, as compared with 277 tons in 1920. There were no shipments of sphalerite concentrates. The lead was obtained by scrappers, for the mines are flooded. The Eagle Picher Lead Co. leased most of the old mining territory and did some drilling. When prices of ore advance, the mines will be unwatered and operations resumed.

Blue Mound-Baxter Springs district.—Notwithstanding adverse conditions, there was considerable activity in that part of Cherokee County south and west of Baxter Springs and north of the Oklahoma State line. Considerable drilling was done to locate bodies of ore, shafts were sunk, and several mills were erected.

Most of the output in 1921, as in 1920, came from mines north and northwest of the Picher area and close to the State line, although mines north of Hockerville and east and north of Blue Mound produced much more than in 1920.

The shipments of concentrates, which in 1920 amounted to 19,831 tons of galena and 94,565 tons of sphalerite, were 22,346 tons of galena and 52,762 tons of sphalerite. The average lead content of the galena sold was 81.6 per cent, and the zinc content of the sphalerite concentrates sold was 60.1 per cent. The crude ore ("dirt") milled yielded 8.05 per cent in concentrates, and at some mines the recovery was more than 16 per cent. Of the total shipments 56 per cent came from mines west and northwest of Blue Mound, which shipped 74.8

per cent in 1920. The production of zinc concentrates was considerably more than the shipments, and a few operators have large stocks of sphalerite in bins at mines near Blue Mound.

The largest producing properties in the area west and northwest of Blue Mound were the State Line Zinc Co. (Blue Diamond), Vinegar Hill (Barr), Webber, Big Elk, Lawyers, Boska, (old Redskin) King Brand, and Muncie. The producing properties north of Hockerville and Zincville and east and north of Blue Mound were the Hartley (Chanute Spelter Co.), Kansas Line, Monarch, Commonwealth No. 2, Euterpe, Empire, Homestake, and Queen Esther. The Webber mill operated on very rich ore and produced more lead than any mine in the Joplin region. The production of sphalerite was also large, though none of the concentrates were sold in 1921.

New concentrating plants were erected by the Homestake Mining Co. (150 tons), Iowa Mining Co. (200 tons), West Side Mining Co. (250 tons), and King Brand Mining Co. (200 tons). The Hartley 500-ton mill of the Chanute Spelter Co. was operated steadily and made the largest output of sphalerite, and the Hartley mine and the Webber mine of the Commerce Mining & Royalty Co. produced two-thirds of all the lead sold in 1921. Several new shafts were sunk on leases north and northwest of the Hartley mine, and a mill was built but not operated on the Brewster land, where development has shown extensive ore deposits. A new mill is to be erected on the Ebenstein land, north of the Hartley tract.

KENTUCKY.

By J. P. Dunlop.

Lead and zinc deposits are found in both central and western Kentucky. None of the mines in the central districts reported any lead or zinc concentrates shipped in 1921. The deposits in the fluorspar region of western Kentucky are chiefly in Crittenden, Caldwell, and Livingston counties and form a continuation of those in the southern Illinois lead and zinc region.

Considerable quantities of galena ores have been produced in former years, but at present lead is obtained solely as a by-product in the recovery and concentration of fluorspar, which is the principal economic mineral. The galena recovered is argentiferous, the silver content varying from a very small quantity to more than 3 ounces a ton, but no recovery of this silver content has been reported by the smelters during the last ten years.

Mine production of lead and zinc in Kentucky, 1907–1921.

Year.	Ores.						Metal content.			
	Lead concentrates (galena).		Zinc concentrates.				Lead.		Zinc.	
			Sphalerite.		Zinc carbonate.					
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1907–1915..	709	$31,602	723	$31,717	4,909	$160,669	480	$44,390	2,040	$342,886
1916.....	227	16,868	125	6,407	2,923	126,875	153	21,114	1,096	293,728
1917.....	184	15,415	.....	.....	2,299	78,368	123	21,156	751	153,204
1918.....	255	21,066	.....	.....	927	30,390	185	26,270	315	57,330
1919.....	120	7,250	.....	.....	120	3,600	86	9,116	36	5,256
1920.....	172	12,295	.....	.....	25	750	122	19,520	9	1,458
1921.....	100	3,693	.....	.....	621	19,800	69	6,210	220	22,000

The average lead content of galena concentrates in 1920 and 1921 was 71 per cent. The total value of the lead and zinc concentrates shipped from Kentucky mines was $23,493, against $13,045 in 1920.

The principal seller of galena concentrates was the Kentucky Fluorspar Co. The American Spar Co. operated the Hudson mine of the Eagle Fluorspar Co., near Salem, in Livingston County, part of the year. The ore was taken from workings about 85 feet in depth and treated in log washers before shipment.

MICHIGAN.

By F. Begeman.

PRODUCTION.

The smelter output of refined copper in Michigan in 1921 was 100,918,001 pounds, as compared with 153,483,952 pounds in 1920. The difference between the mine and the smelter production is due to the fact that the quantity of concentrates or "mineral" produced is not the same as the quantity smelted. A company may produce either more or less "mineral" than it smelts during the year.

Mine production of silver and copper in Michigan in 1920 and 1921.[a]

Year.	Silver (fine ounces).	Copper.			Concentrate ("mineral").		Ore ("rock") (short tons).
		Pounds.	Yield.		Pounds.	Yield (per cent).	
			Pounds per ton of ore ("rock").	Percentage.			
1920.....	470,189	[b] 154,695,073	23.7	1.18	[c] 281,745,025	54.9	5,938,967
1921.....	[d] 310,727	[b] 86,370,028	23.9	1.19	[c] 148,024,931	58.4	[e] 3,610,648
Increase or decrease.....	−159,462	−68,325,045	+0.2	+0.01	−133,720,094	+3.5	−2,328,319

[a] The figures are based on the actual recovery of copper from "mineral" smelted and the estimated recovery from "mineral" that was not smelted during the year.
[b] Includes copper from sands.
[c] Includes "mineral" from sands.
[d] Derived from the electrolytic treatment of 27,434,650 pounds of copper.
[e] Includes sands.

Value of silver and copper produced in Michigan mines in 1920 and 1921.

Year.	Silver.	Copper.		Total.
		Total.	Per ton of ore ("rock").	
1920	$512,506	$28,463,893	$4.79	$28,976,399
1921	310,727	11,141,734	3.09	11,452,461
Decrease, 1921	201,779	17,322,159	1.70	17,523,938

HOUGHTON COUNTY.

Houghton County occupies the central portion of the copper belt and contains 8 of the 11 mines that produced copper in 1921 and all the mines that produced silver.

The Calumet & Hecla Mining Co. has been one of the most successful copper-mining companies in the world. To the end of 1921 it has distributed $152,250,000 in dividends. The company's ground contains three copper-bearing lodes—the Calumet & Hecla conglomerate, the Osceola amygdaloid, and the "Kearsarge" amygdaloid; but only the first was productive in 1921.

The company's annual report shows the details of operation for 1921 as follows: In all, 261,320 short tons of "rock" was treated, yielding 9,865,400 pounds of copper, or an average of 37.75 pounds per ton of "rock," compared with 27.87 pounds for 1920. The total cost per pound of copper was 19.10 cents, including 5.63 cents for depreciation and depletion. The recovery of copper from old sands added to the recovery from "rock" made a total production of 15,167,136 pounds.

The reclamation plant for treating old tailings from Torch Lake treated 367,000 tons having an average copper content of 14.45 pounds to the ton. A total of 5,301,736 pounds of copper was recovered, at an average cost, exclusive of smelting and selling, of 5.98 cents. This figure includes the expense of maintenance from April 1 to December 31, during which the plant was not operating, amounting to 0.6 cent a pound for the year, and since starting to 0.06 cent a pound.

Summary of operations of regrinding plant, Calumet & Hecla Mining Co., 1921.

	From mine.	From old sands.
Ore treated.....short tons..	143,726	227,559
Assay of headings.....per cent..	0.677	0.888
Assay of tailings.....do....	0.451	0.492
Refined copper.....pounds..	653,700	1,814,300
Refined copper per ton treated.....do....	4.55	7.97
Cost per pound, exclusive of smelting and selling.....cents..	6.38	5.16

Summary of operations of leaching plant, Calumet & Hecla Mining Co., 1921.

Ore treated	short tons	349,070
Assay of headings	per cent	0.624
Assay of tailings	do	0.125
Refined copper	pounds	3,698,136
Refined copper per ton treated	do	10.59
Cost per pound of copper, exclusive of smelting and selling	cents	4.74

At the beginning of 1921 conditions in copper mining were most unsatisfactory; wages were high, and the prices of coal, powder, and all other mining supplies were prohibitive when compared with the market price of copper; the high rate for transporting rock and copper established by the railroads when under Government control had not been reduced; the production of copper very much exceeded the demand; the surplus of copper in the hands of the mining companies was being increased monthly; and the market price for the metal was below the cost at which most mines could produce it. As these adverse conditions continued and might continue for an indefinite period, it seemed useless to continue producing copper with so large a surplus on hand and with so little prospect of disposing of it at an adequate price; consequently all operations were suspended on April 1 and were not resumed during the rest of the year.

No copper was produced by the Osceola Co. in 1921, all mining operations having been suspended in November, 1920. Since 1878 this company has distributed dividends amounting to $17,756,375. Aside from the installation of the electric pumps at Nos. 1 and 4 shafts, North Kearsarge, a few men were employed in making shaft repairs and a few watchmen to guard the property; no others were employed during the year.

The Wolverine Co. was among the larger producers of copper for 1921. The published report of the company for the fiscal year ending June 30, 1922, is not yet available, and it is therefore not possible to give a detailed statement of its operations.

At the Quincy 767,100 tons of "rock" was mined, which yielded 29,021,930 pounds of "mineral" and 16,960,265 pounds of copper, an average of 22.12 pounds per ton. Total disbursements in dividends since 1862 amounted to $27,002,500.

At Isle Royale "rock" amounting to 116,576 tons was treated, yielding an average of 21.37 pounds of copper to the ton. The average cost per pound of copper was 20.57 cents, including 3.46 cents for depreciation and depletion. All operations were suspended on April 1, and remained suspended during the rest of the year.

A total of 195,816 tons of "rock" from the Baltic mine was stamped, producing 34.15 pounds of refined copper per ton. The cost per pound of refined copper was 14.15 cents. A total of 143,172 tons of "rock" from the Trimountain was stamped, yielding an average of 30.32 pounds per ton, at an average cost per pound of 17.23 cents. Since its organization the company has disbursed $3,250,000 in dividends. The Champion Copper Co. is controlled jointly by the Copper Range Co. and the St. Mary's Mineral Land Co. A total of 531,780 tons of "rock" was stamped, which produced 39.018 pounds of copper per ton, at a cost of 19.64 cents per pound. Since its organization the company has disbursed $25,850,-260.96 in dividends.

A small production is reported by the Seneca Copper Corporation in 1921. The developments during the year were entirely satisfactory and will be continued vigorously, so as to make the proper physical connection between the Gratiot and Seneca openings, to the end that production may be started as soon as conditions warrant. The crushing and screening plant produced 8,927 tons of crushed rock, most of which was marketed, the rest being used at the mine. During the year two new hoisting drums were purchased to replace old ones on the hoisting engine. The underground development work at the Seneca mine proper, through No. 1 shaft, was continued during the year without interruption.

The Arcadian Consolidated Mining Co. did not produce any copper during 1921, its operations being confined to sinking a shaft and drifting north and south. One shaft is now down 1,850 feet and the other 1,100 feet. Work continued without interruption during the year, and about 35 men were employed.

The mines of the Centennial Copper Mining Co., Franklin Mining Co., Superior Copper Co., La Salle Copper Co., Winona Copper Co., and Hancock Consolidated Mining Co. were idle during the year.

KEWEENAW COUNTY.

Keweenaw County occupies the northern portion of the copper belt.

At the Ahmeek mine 212,170 tons of "rock" was stamped and yielded 29.48 pounds of refined copper to the ton, at a total cost per pound of 14.56 cents, including 4.27 cents for depreciation and depletion. Total dividends to the end of 1920 amounted to $12,150,000.

At the Mohawk mine 703,260 tons of "rock" was stamped and yielded 14,054,235 pounds of copper, or an average of 20.42 pounds to the ton, at a total cost per pound of 15.598 cents.

The Allouez Mining Co. produced no copper in 1921, having suspended mining operations in July, 1920. Its total dividends to April, 1919, amounted to $2,850,000.

ONTONAGON COUNTY.

The only metal output in Ontonagon County came from the Victoria Copper Mining Co. "Rock" amounting to 20,400 tons was stamped and yielded 273,916 pounds of "mineral." The operations for the year were confined to the hoisting of rock broken in upper levels of the mine prior to 1920. The ore from these stopes was not as high in copper content as that from the lower levels. There was no development work of any kind and a very small amount of stoping in 1921. During the last part of April operations were suspended, and the mine has been idle since that time except for some repairs to the shaft.

No active mining operations were carried on at the properties of the Michigan Copper Mining Co., South Lake Mining Co., White Pine Copper Co., Lake Copper Co., and Mass Consolidated Mining Co.

MISSOURI.

By J. P. Dunlop.

PRODUCTION.

The value of the mine production of recoverable silver, copper, lead, and zinc in Missouri in 1921 was $17,379,801, compared with $30,788,135 in 1920. The value of copper decreased $260,558, that of lead $10,210,590, that of silver $51,228, and that of zinc $2,885,958. The recoverable lead content of Missouri lead concentrates sold in 1921 was equal to 45 per cent of the smelter production of primary lead in the United States derived from domestic ores, against 35 per cent in 1920, and the recoverable zinc content from Missouri zinc concentrates sold in 1921 was 5.5 per cent of the primary zinc produced by smelters from domestic ores in 1921, as against 22.7 per cent in 1917.

Mine production of silver and copper in Missouri, 1910–1921.

Year.	Copper.		Silver.		Lead concentrates, silver bearing (short tons).
	Pounds.	Value.	Fine ounces.	Value.	
1910–1918	3,527,293	$667,666	510,920	$333,582	495,823
1919	1,617,200	300,799	[a] 90,401	101,249	81,000
1920	1,512,539	278,307	[b] 111,128	121,130	90,000
1921	137,591	17,749	69,902	69,902	44,000

[a] Includes 29,480 ounces of silver from cobalt-nickel-copper ore.
[b] Includes 28,664 ounces of silver from cobalt-nickel-copper ore.

The quantities given in the third column of the foregoing table are those of recovered silver. The silver content of the lead ores is so small that it is disregarded in the assay and sale of the concentrates. For this reason the smelter reports must be relied on for the silver production. As may be seen by inspection of the table, the quantity of silver produced in any year bears no direct ratio to the quantity of lead concentrates smelted during that year, for the reason that the silver content is so small in quantity that the silver bullion is stored and refined in batches. In a series of years the concentrates average less than 1 ounce of silver to the ton.

The North American mine, now owned by the Missouri Cobalt Co., produced no silver, copper, nickel, or cobalt in 1921. The copper was derived from concentrates recovered in dressing lead ore mined in St. Francois County, in southeastern Missouri, and about 462 ounces of the silver reported from Missouri in 1921 was derived from copper concentrates from lead ores.

The value of the recoverable metallic content of the lead and zinc concentrates produced in Missouri in 1921 was $17,292,150, a decrease of $13,096,548 from that of 1920. The production of lead concentrates (of which all but 34 tons was galena) was 282,122 short tons, as compared with 247,205 tons in 1920. Of the output in 1921, 280,358 tons was derived from southeastern and central Missouri, an increase of 38,110 tons. The average metal content of the lead concentrates from these districts was 65 per cent, as compared with

66.6 per cent in 1920, and the value per ton in 1921 was $41.87. The quantity of recoverable lead in southeastern and central Missouri concentrates in 1921 amounted to 178,735 tons, an increase of 17,477 tons.

Shipments of galena concentrates from southwestern Missouri were 1,730 tons, compared with 4,937 tons in 1920. The lead carbonate concentrates amounted to 34 tons, an increase of 14 tons. The quantity of recoverable lead from southwestern Missouri, or the Joplin region, was 1,350 tons, a decrease of 2,506 tons. The average metal content of the galena concentrates from southwestern Missouri was 78.4 per cent, and the average price per ton was $50.15, or $47.69 less than in 1920.

The quantity of zinc blende concentrates sold from Missouri mines was 19,490 tons, a decrease of 19,941 tons compared with 1920. All the blende concentrate was produced in southwestern Missouri. The average price received per ton was $25.18, and the average recoverable zinc content reported by the sellers was 61.7 per cent, compared with $45.79 and 59.5 per cent in 1920.

The zinc carbonate and silicate concentrates sold amounted to 60 tons, or 9,434 tons less than in 1920. The output in 1921 was entirely from southwestern Missouri. The average metal content of the zinc carbonate and silicate concentrates was 38.3 per cent, and the average price per ton was $10.57, compared with $35.50 in 1920.

The combined value of lead and zinc concentrates from southeastern and central Missouri (which produced about 99 per cent of the lead concentrates) was $11,737,400, or $8,063,899 less than in 1920. The total value of the lead and zinc concentrates from southwestern Missouri was $579,245, compared with $2,626,186 in 1920.

The total quantity of crude ore or "dirt" mined and treated in Missouri in 1921 was 5,302,100 short tons. As the total amount received for all classes of lead and zinc concentrates sold in 1921 was $12,316,645, the average value per ton of crude ore or "dirt" mined and treated was $2.32.

In the following tables showing the tenor of crude ore ("dirt") and concentrates from Missouri it has been considered advisable to segregate the ores of different nature. The disseminated lead ore of southeastern Missouri differs radically from the lead and zinc ores of the so-called "soft ground" deposits of southwestern Missouri. Each class of ore has its peculiar problems of mining and ore dressing. The data are given for the ores mined in the Joplin region, but as the recoveries from "sheet ground" were very small in 1920 and 1921 it was not possible to differentiate between the "soft ground" and "sheet ground" recoveries. In general, the tables reflect very closely the conditions of the industry.

Mine production of lead and zinc in Missouri in 1921, by districts.

District.	Lead concentrates.				Zinc concentrates.			
	Galena.		Carbonate.		Sphalerite.		Silicate and carbonate.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Alba-Neck City	35	$1,556			4	$78		
Carthage	16	736			30	690		
Cave Springs-Belleville	30	1,286			116	2,608		
Duenweg-Porto Rico	62	2,540			4	105	9	$56
Joplin	396	20,461	33	$1,090	139	3,706	32	355
Oronogo	143	7,693			91	1,950		
Spurgeon-Seneca	93	5,194	1	24			19	223
Stark City	20	1,050						
Webb City-Carterville-Prosperity	790	40,646			281	5,366		
Waco	145	5,604			18,277	465,894		
Wentworth					548	10,334		
	1,730	86,766	34	1,114	19,490	490,731	60	634
Southeastern Missouri	280,358	11,737,400						
	282,088	11,824,166	34	1,114	19,490	490,731	60	634
Total, 1920	247,185	20,283,887	20	1,034	39,431	1,805,561	9,494	337,003

District.	Metal content.[a]			
	Lead.		Zinc.	
	Short tons.	Value.	Short tons.	Value.
Alba-Neck City	27	$2,430	2	$200
Carthage	12	1,080	15	1,500
Cave Springs-Belleville	21	1,890	62	6,200
Duenweg-Porto Rico	46	4,140	5	500
Joplin	329	29,610	84	8,400
Oronogo	112	10,080	45	4,500
Spurgeon-Seneca	73	6,570	7	700
Stark City	16	1,440		
Webb City-Carterville-Prosperity	604	54,360	142	14,200
Waco	110	9,900	10,199	1,019,900
Wentworth			284	28,400
	1,350	121,500	10,845	1,084,500
Southeastern Missouri	178,735	16,086,150		
	180,085	16,207,650	10,845	1,084,500
Total, 1920	165,114	26,418,240	24,509	3,970,458

a In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc in 1921. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average sales price for all grades.

Tenor of crude lead and zinc ore and concentrates produced in southwestern Missouri in 1919, 1920, and 1921.

	1919	1920 [a]	1921 [a]
SOFT GROUND.[b]			
Total crude ore.....short tons..	1,114,300	1,304,400	243,300
Total concentrates in crude ore:			
Lead.....per cent..	0.48	0.40	0.73
Zinc.....do....	5.24	3.75	8.04
Metal content of crude ore:			
Lead.....do....	.38	.31	.57
Zinc.....do....	2.90	2.09	4.95
Average lead content of galena concentrates.....do....	77.8	77.7	78.4
Average lead content of lead carbonate concentrates.....do....	53.0	55.0	58.8
Average zinc content of sphalerite concentrates.....do....	58.9	59.5	61.7
Average zinc content of silicates and carbonates.....do....	40.3	39.8	38.3
Average value per ton:			
Galena concentrates	$65.06	$97.84	$50.15
Lead carbonate concentrates	$35.65	$51.70	$32.76
Sphalerite concentrates	$41.33	$45.79	$25.18
Zinc silicates and carbonates	$27.33	$35.50	$10.57
SHEET GROUND.			
Total crude ore.....short tons..	274,500	(b)	(b)
Total concentrates in crude ore:			
Lead.....per cent..	1.01		
Zinc.....do....	1.82		
Metal content of crude ore:			
Lead.....do....	.82		
Zinc.....do....	1.05		
Average lead content of galena concentrates .....do....	81.1		
Average zinc content of sphalerite concentrates.....do....	54.9		
Average value per ton:			
Galena concentrates	$70.30		
Sphalerite concentrates	$35.03		

[a] Includes all ore mined and milled, 1920 and 1921.
[b] Quantity of ore from "sheet ground" very small; it is included with ore from "soft ground" in 1920 and 1921. Part of the concentrates shipped in 1921 was from ore milled in 1920.

Tenor of crude lead ore and concentrates in southeastern Missouri disseminated lead ore in 1919, 1920, and 1921.

	1919	1920	1921
Total crude lead ore.....short tons..	4,301,930	4,803,630	5,058,800
Galena concentrates in crude ore.....per cent..	5.32	5.04	5.54
Lead content of crude ore.....do....	3.65	3.35	3.60
Average lead content of galena concentrates.....do....	68.4	66.6	65.0
Average value per ton of galena concentrates	$50.46	$81.72	$41.87

In Mineral Resources for 1914, Part I, pages 72–77 and 97–100, was given a brief history of lead and zinc mining in the southeastern Missouri and Joplin regions, together with data relating to the total lead and zinc production, the mining and milling practice, the character of the ore and concentrates, and the methods of selling them.

In order to expedite the publication and distribution of this report many of the data relating to individual properties as given in previous reports under the reviews by districts have been omitted. All the essential data relating to the districts are included in the yearly State review of the regions.

SOUTHWESTERN MISSOURI.

AREA AND PRODUCTION.

The southwestern Missouri lead and zinc areas include the largest part of the Joplin region, the remainder lying in southeastern Kansas and northeastern Oklahoma.

Lead and zinc concentrates produced in the Missouri part of the Joplin region, 1907–1921.

	Short tons.	Value.	Average price.
Lead concentrates	438,495	$27,761,121	$63.31
Sphalerite concentrates	2,715,612	139,331,489	$51.31
Zinc carbonate and silicate concentrates	288,273	8,974,624	$31.13
	3,442,380	176,067,234	.....

PRICES.

The following quoted base prices apply not only to southwestern Missouri but also to all the mines in Oklahoma and Kansas that are in the Joplin region. The average quoted base prices for 60 per cent sphalerite were highest during January, 1921. The prices were $27 to $29 a ton in the first week in January and steadily declined during January and February. The March prices were as low as $20, but the April prices increased to $23 and $24, and the May prices were $24 to $26. Prices declined again in June and July, averaging $20 to $21, and remained about the same during August and September, though reaching $19 in August. In October they returned to an average of $24, in November they advanced to $25, and in December they ranged from $26 to $29.

Base prices for calamine or zinc silicate ores were not quoted during most of 1921, for very little ore was mined, and the sales were made in small lots at prices ranging from $10 to $12 a ton. There was naturally a very small demand for carbonate and silicate containing 40 per cent zinc when quotations for 60 per cent sphalerite were $20 to $25 a ton.

The quoted price for galena carrying 80 per cent of lead showed wide variations. In January it was $48 to $50 a ton and in December $57 and $58. The highest price received was $58 a ton in December, and the lowest $32 in February. The high prices did not stimulate the production of lead from southwestern Missouri, for there was a large decrease in output.

Average prices per ton paid for sphalerite and zinc and lead concentrates in Missouri, 1915–1921.

	1915	1916	1917	1918	1919	1920	1921
Sphalerite	$76.25	$82.60	$71.04	$51.27	$40.67	$45.79	$25.18
Zinc silicate or carbonate concentrates	45.00	50.21	40.50	32.27	27.30	35.50	10.57
Galena concentrates	52.52	84.29	101.90	89.92	66.82	97.84	50.15

These prices are not averages of base-price quotations but averages calculated from the quantity sold and the amounts received as reported to the United States Geological Survey by the sellers.

GENERAL CONDITIONS.

Prices for both lead and zinc concentrates were much below normal in 1921, and there was again a large decrease in the total mine output from the Missouri part of the Joplin region. A little prospecting was done in the Webb City-Carterville-Prosperity area. Development and mining of "sheet ground" ceased entirely. Few properties are now equipped with plants, and only the huge piles of tailings mark the former activities at the large camps. Part of the zinc concentrates shipped in 1921 were made in 1920. The Waco district (in Missouri only) produced more than 93 per cent of the entire output of sphalerite shipped from southwestern Missouri in 1921. The mines at Waco that contributed the 18,277 tons of sphalerite and 145 tons of galena were those of the Barnsdall Zinc Mining Co. and the Tulsa Pittsburg Mining Co. No concentrates were sold from any mines in the Carl Junction, Thoms Station, Sarcoxie-Reeds, Aurora, Ash Grove, Granby, Spring City, or Springfield districts. The Arista mine, at Wentworth, shipped more sphalerite than any other property except the Barnsdall, at Waco.

The production in the Carthage, Neck City, Duenweg, Webb City-Carterville, and Spurgeon districts was scattered and small. The only property at Cave Springs that yielded sphalerite was that of the Imperial Zinc Co.

The two large mines at Oronogo, the Oronogo Circle and Oronogo Mutual, produced a little galena and sphalerite, but the Oronogo Mutual mine was abandoned and the mill dismantled and the Oronogo Circle plant was closed early in the year, though preparations were made in December to resume operations. No large plants near Joplin were operated steadily, but a number of small operators shipped 396 tons of galena, 139 tons of sphalerite, and 32 tons of zinc silicate. Most of the output came from leases of the Missouri Lead & Zinc Co., Connor Investment Co., Mattes land (old Bullfrog), and F. F. Creller.

The Webb City-Carterville-Prosperity district had a small output compared with that of former years. The shipments were 790 tons of galena and 281 tons of sphalerite. The largest production of both lead and zinc was made by lessees on the Connor land. Other properties that yielded shipments of lead or zinc were those of the American Zinc, Lead & Smelting Co., Center Creek Mining Co., Eleventh Hour Mining Co., old Troop 40 acres, and Elliot land. Most of the shipments from the district consisted of ores from scrapping and clean-ups. At the end of 1921 few companies were mining ore in southwestern Missouri, and the only large plants in operation were the Barnsdall and the Tulsa Pittsburg, at Waco and the Connecticut Zinc Co., at Oronogo.

CENTRAL AND SOUTHEASTERN MISSOURI.

A brief description of the ore deposits in central and southeastern Missouri is given in the separate chapter entitled "Silver, copper, lead, and zinc in the Central States in 1915," which may be obtained

upon application to the Director, United States Geological Survey, Washington, D. C.

Copper, nickel, and cobalt occur in the ore, in considerable quantity in the vicinity of Fredericktown, and in small quantity irregularly in nearly all deep mines. It is only near Fredericktown that the copper, nickel, and cobalt content of the ore has been the object of mining, yet a concentrate of these metals has been recovered as a table middling at several plants in other parts of the district.

In the disseminated-ore district the production after 1869 increased rapidly and is estimated by Buckley to have amounted to 1,202,607 tons of lead concentrates, valued at $59,869,354, for the period between 1869 and 1906, inclusive. The mine production of southeastern and central Missouri has been reported to the United States Geological Survey since 1907.

Mine production of lead and zinc concentrates in southeastern and central Missouri, 1907–1921.

Year.	Lead concentrates (galena).		Zinc concentrates.			
			Sphalerite.		Carbonate and silicate.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1907–1915	1,945,996	$85,207,971	452	$13,108	8,435	$168,929
1916	307,025	20,720,737	365	14,400	1,030	42,129
1917	306,473	30,070,995	186	16,344	293	7,145
1918	271,506	20,507,064	13	285	235	6,845
1919	229,687	11,590,977	.....	.....	231	6,576
1920	242,248	19,799,389	.....	.....	61	1,910
1921	280,358	11,737,400	.....	.....	.....	.....

The output of silver in Missouri in 1921 was derived mainly from refining pig lead, but about 462 ounces was obtained from copper concentrates recovered in dressing lead ores, which were shipped to smelters. The silver was recovered from about 44,000 tons of lead concentrates and from copper concentrates that averaged more than 1 ounce to the ton.

The crude lead ore mined in the disseminated-lead district, amounting to 5,058,800 short tons, yielded 5.54 per cent of lead concentrates, which averaged 65 per cent of lead. The average value per ton of the lead concentrates was $41.87, compared with $81.72 in 1920, and the concentrates were slightly lower in lead content than in 1920. The output of galena concentrates was 280,173 tons, against 242,004 tons in 1920. As several of the large producers not only mine but also smelt their lead concentrates, the values given for concentrates are to a certain extent arbitrary. The galena concentrates produced in the southwestern Missouri region, which contain a higher lead content, are sold mainly on bids from purchasers, and the prices for those concentrates are not comparable with prices given for concentrates of the disseminated-lead districts.

Analyses of ores mined in the disseminated-lead district in southeastern Missouri and of the various grades of resulting concentrates are given in Mineral Resources for 1919 and 1920.

There were no shipments of zinc carbonate from southeastern Missouri during the year; 61 tons was shipped in 1920.

The quantity of galena recovered from shallow diggings in Washington and Jefferson counties was only 185 tons. The ore, which occurs at shallow depths in association with barytes, is mined in a small way and at odd times by the barytes miners. Much of this ore was purchased by J. F. Evans, of Potosi. Small sales of lead were made by Johnson Bros., of Fletcher, and at the end of 1921 the De Soto Lead & Zinc Co., National Pigments & Chemical Co., and Washington Lead Mining Co. held small stocks of lead.

The 300-ton concentrating plant and the 100-ton smelter and refinery of the Missouri Cobalt Co., at Fredericktown, were not operated in 1921.

Nearly all the lead produced in southeastern Missouri was mined by the National Lead Co., St. Joseph Lead Co., Desloge Consolidated Lead Co., and Federal Lead Co. The St. Joseph Lead Co. was the largest producer. There were no important changes in the equipment of any of the mining plants.

Some development work that yielded a considerable quantity of galena was done on the Eagle Picher property, near Morrellton, in Franklin County, which was purchased in 1920.

OKLAHOMA.

By J. P. Dunlop.

Mine production of lead and zinc in Oklahoma in 1921, by districts.

District.	Ores.					
	Lead concentrates (galena.)		Zinc concentrates.			
			Sphalerite.		Carbonate and silicate.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Miami	52,234	$2,741,010	225,506	$5,148,714	.....	.....
Peoria and Quapaw	2	100	63	1,440	.....	.....
Total, 1920	52,236	2,741,110	225,569	5,150,154	.....	.....
	81,464	7,652,052	407,569	18,320,875	14	$462

District.	Metal content.[a]			
	Lead.		Zinc.	
	Short tons.	Value.	Short tons.	Value.
Miami	41,551	$3,739,590	121,339	$12,133,900
Peoria and Quapaw	1	90	33	3,300
Total, 1920	41,552	3,739,680	121,372	12,137,200
	65,394	10,463,040	219,727	35,595,774

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc in 1921. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price of all grades.

The following table gives the output of crude lead and zinc ore for the whole State of Oklahoma. Formerly it was thought advisable to calculate the tenor of crude ore and concentrates as well as assay content and value of concentrates separately for the Miami and Quapaw districts, inasmuch as the character of the ground operated in these districts had, until the new mines in the easterly extension of the Miami district, near Quapaw, were opened in 1918, differed so radically that general calculations for the State would have been valueless. For 1921, however, there is no necessity for such separation, as all the mills in the Quapaw district were idle.

Tenor of lead and zinc ore and concentrates produced in Oklahoma, 1920 and 1921.

	1920	1921
Total crude ore milled in Oklahoma.....short tons..	6,943,100	2,969,500
Miami district:		
Total concentrates in crude ore—		
Lead.....per cent..	1.18	1.76
Zinc.....do....	5.87	7.60
Metal content of crude ore—		
Lead.....do....	.92	1.43
Zinc.....do....	3.52	4.54
Average lead content of galena concentrates.....do....	80.2	81.0
Average zinc content of sphalerite concentrates.....do....	59.9	59.8
Average value per ton—		
Galena concentrates.....	$93.93	$52.48
Sphalerite concentrates.....	$44.96	$22.83
Quapaw district:		
Total concentrates in crude ore—		
Lead.....per cent..	.13	.....
Zinc.....do....	5.49	.....
Metal content of crude ore—		
Lead.....do....	.10	.....
Zinc.....do....	3.23	.....
Average lead content of galena concentrates.....do....	75.6	.....
Average zinc content of sphalerite concentrates.....do....	58.8	.....
Average value per ton—		
Galena concentrates.....	$93.95	.....
Sphalerite concentrates.....	$42.14	.....

Mine production of lead and zinc concentrates in Oklahoma, 1891–1921, by districts.

District.	Lead concentrates (mainly galena).		Zinc concentrates.			
			Sphalerite.		Zinc silicate and carbonate.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Peoria.....	2,166	$106,058	220	$8,289	2,738	$73,432
Quapaw.....	4,137	267,196	35,851	1,546,266	164	2,692
Miami.....	361,053	27,896,641	1,602,921	72,507,546	.....	.....
Davis.....	.....	.....	558	27,399	899	24,592
	367,356	28,269,895	1,639,550	74,089,500	3,801	100,716

Mineral Resources for 1914 contains a brief history of mining in the districts in Oklahoma and also the estimated total production of each district, by years.

The total value of the lead and zinc concentrates shipped from Oklahoma in 1921 was more than three times as much as the value in 1915.

The lead and zinc deposits of northeastern Oklahoma, so far as known, are confined to Ottawa County and form the southwestern extension of the deposits in the Joplin region. There are three camps, Peoria, Quapaw, and Miami, in which extensive mining has been done, and a fourth, the Sycamore Creek district, along the Seneca fault block from 2 to 3 miles southwest of Seneca, Mo., in which considerable prospecting has been done and some ore mined. The lead and zinc deposits in southern Oklahoma are near Ravia, at the southeast end of the Arbuckle Mountains, and near Davis, Murray County, at the northwest end of the same range.

The quantity of crude ore milled in Oklahoma decreased 3,973,600 tons in 1921, and the quantity of ore milled by the old mines near Commerce and at Quapaw was negligible. The value of the recoverable lead and zinc produced at mines in Oklahoma was $15,876,880, compared with $46,058,814 in 1920. The metal content of lead concentrates decreased from 65,394 to 41,552 tons, and the recoverable zinc from 219,727 to 121,372 tons.

The lead concentrates produced were of slightly higher grade than those shipped in 1920. The average metal content of the sphalerite concentrates from the Miami ore has increased from 51.8 per cent in 1912 to 59.8 per cent in 1921, although the average zinc content of the sphalerite recovered from ore and tailings at the old mines near Commerce in 1921 was only 50 per cent.

The Miami district (in Oklahoma only) produced about 68 per cent of the total output of lead concentrates in the Joplin region and yielded nearly all the sphalerite concentrates and galena concentrates sold in Oklahoma. The Oklahoma shipments of sphalerite decreased 182,000 tons.

A history of the mining in the Miami district, including the output by years for 1908 to 1914, and of the location of the mines and mills, was given in Mineral Resources for 1914. The reports for 1915 to 1919 contain full reviews of the production, new territory prospected, new mines opened, and new mills erected in those years. A brief description of the ore deposits in the Miami district is given in Mineral Resources for 1915.[6]

The mines of the Oklahoma part of the Miami district in 1921 shipped 52,234 short tons of galena concentrates and 225,506 short tons of sphalerite concentrates, a decrease of 29,179 tons of galena concentrates and of 180,362 tons of sphalerite concentrates compared with the output of 1920. The average price of the galena concentrates decreased $41.45 a ton, and the average price of sphalerite concentrates, of which more than four times as much was shipped, decreased $22.13 a ton. Only a few of the milling plants were operated at capacity, and many were idle all or part of the year.

Many mines recovered large quantities of galena, which made operation possible, if not very profitable, even after sphalerite prices had decreased to $20 and $22. The operating costs at Miami are greater than in most of the other districts in the Joplin region, and the royalties paid averaged 50 per cent more. The increased recovery of concentrates in the Miami district and the larger quantity of galena recovered compensated for the higher operating costs, but it is certain that many of the Miami mines were not operated profit-

[6] Siebenthal, C. E., Zinc: U. S. Geol. Survey Mineral Resources, 1915, pt. 1, pp. 888–890, 1917.

ably. Wages were lower, but mining costs decreased comparatively little, especially such large items of expense as powder, steel, coal, and electric power. Some mines having rich ore were operated at a profit during 1921, as when prices declined many of them were forced to mine only the higher-grade ore bodies, especially those containing lead. A large number of mines opened drifts on zinc ore bodies that will be mined as the selling price and demand for ore advance, but this ore, being of lower grade, will preclude much profit to operators.

Many of the mines shipped concentrates made in 1920, and others were operated part of the year only. Some companies operated without profit to take care of their employees. Some operators having rich ore bodies with only a limited period in which to remove ore preferred to operate on a very small margin rather than close. Labor was plentiful and efficient. All the mines are provided with adequate shipping facilities by rail and roadway. Few mining districts have better facilities for transportation of supplies and men.

The production in the Miami district (in Oklahoma) was that of about 85 mills, of which 2 were in the old Commerce camp and the remainder in the territory north and northeast to the Kansas State line and east to Quapaw. In the northerly extension of the Miami field in Kansas about 20 mills were in operation at different times in 1921. Many of the mills were operated intermittently. It is estimated that in 1921 there were more than 200 concentrating plants—many of them of large capacity—in Ottawa County.

The quantity of crude ore mined and milled decreased from approximately 6,912,000 tons in 1920 to 2,970,000 tons in 1921. The ore treated has showed an increase in concentrates recovered from 5.5 per cent in 1917 to 6.45 per cent in 1918, 6.6 per cent in 1919, 7.05 per cent in 1920, and 9.36 per cent in 1921. The average metal content of the sphalerite was 51.8 per cent in 1912, 58.8 per cent in 1919, and 59.8 per cent in 1921, so that the total increase in the zinc content of the sphalerite sold has been about 8 per cent in nine years.

The separate assays reported showed the zinc content to range from 40 to 63 per cent, but most of the blende assayed between 59 and 60.5 per cent. An assay of a composite sample of 5,100 samples of ore shipped in 1921 from the Miami-Blue Mound region, made by Bruce Williams, of Joplin, Mo., showed an average content of 60 per cent of zinc, 1.3 per cent of iron, 0.89 per cent of lead, and 0.367 per cent of cadmium. The average zinc content as computed from the reports of all the companies selling concentrates differed only 0.2 per cent from that of the composite sample.

The recovery of concentrates from all the mines averaged about 1 ton of galena to 4.3 tons of sphalerite, which is a much higher average than in any other district in the Joplin region or in Wisconsin. The proportion of galena concentrates recovered from the "dirt" mined showed wide variations in different mines, ranging from less than 1 ton of galena to 100 tons of sphalerite to 1 ton of galena to 1 ton of sphalerite.

The total shipments from those properties that may properly be classed as in the Tar River-Douthat area, of which there were a greater number than in the other areas, amounted to 27,892 tons of

galena and 115,504 tons of sphalerite. About 1,554,000 tons of "dirt" was milled, so that the recovery in concentrate averaged about 9.22 per cent, 2.38 per cent more than in 1920. A few of the mines near Cardin yielded nearly as much galena as sphalerite; in a few mines near Douthat the proportion of galena was as little as 2 per cent; and the proportion of galena to sphalerite on the whole was less than that recovered from the mines near Picher. The proportion of galena to sphalerite recovered at all the mines in the vicinity of Douthat was about 1 ton of galena to 7.2 tons of sphalerite; in the Tar River section the mines yielded about 1 ton of galena to 3.6 tons of sphalerite.

The territory lying east of Picher, near the Hockerville and Zincville (St. Louis) camps, was not as active as in 1920, when the shipments from 20 mines were 6,847 tons of galena and 70,020 tons of sphalerite; in 1921 the shipments from 13 mines were 7,476 tons of galena and 25,881 tons of sphalerite from 313,000 tons of ore treated. The sphalerite averaged about 60.8 per cent of zinc content and the galena 81.8 per cent.

The production of the mines in the vicinity of Picher showed a decrease. In 1920 the quantity of ore milled was 2,966,600 tons, and the shipments were 38,397 tons of galena and 164,884 tons of sphalerite. In 1921 the quantity of ore milled was 1,093,200 tons, and the shipments were 16,468 tons of galena and 83,417 tons of sphalerite, which indicates a recovery of approximately 9.14 per cent in concentrates, compared with 6.85 per cent in 1920.

Several old mills, including the Turkey Fat, at Commerce, were moved to new ground, but otherwise little new equipment was erected and drilling was much less active than in 1919 and 1920. There were few purchases of leases, and only a small amount of development work was done pending the disposal of the problem of new leases on Indian lands now in process of settlement.

The production at Peoria, the oldest mining camp in Oklahoma, was only a few tons of galena mined by small operators at shallow levels. The total production of concentrates in the Quapaw district was small, and none of the mills near Quapaw or Lincolnville were in operation.

WISCONSIN.

By J. P. Dunlop.

Mine production of lead and zinc in Wisconsin in 1921, by districts.

District.	Ores.						Metal content.[a]			
	Lead concentrates.		Zinc concentrates.				Lead.		Zinc.	
			Sphalerite.		Silicate and carbonate.					
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Benton–New Diggings	720	$37,622	2,266	$30,278	.....	.....	545	$49,050	646	$64,600
Cuba City–Hazel Green	277	13,538	1,738	18,701	.....	.....	209	18,810	405	40,500
Livingston–Mifflin	104	5,820	12,008	79,192	.....	.....	80	7,200	2,123	212,300
Platteville–Shullsburg	201	9,207	438	12,039	.....	.....	138	12,420	216	21,600
	1,302	66,187	16,450	140,210	.....	.....	972	87,480	3,390	339,000
Total, 1920	3,526	326,777	101,987	2,308,701	1,943	$41,481	2,647	423,520	27,285	4,420,170

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc in 1921. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price of all grades.

Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1920 and 1921.

		1920	1921
Total crude ore	short tons	1,742,000	136,300
Total concentrates in crude ore:			
Lead	per cent	0.20	0.95
Zinc	do	5.96	12.07
Metal content of crude ore:			
Lead	do	.15	.73
Zinc	do	1.93	3.05
Average lead content of galena concentrates	do	75.0	76.1
Average zinc content of sphalerite concentrates	do	32.4	25.3
Average zinc content of zinc carbonate concentrates	do	26.6	.....
Average value per ton:			
Galena concentrates		$92.68	$50.83
Sphalerite concentrates		$22.64	$8.52
Zinc carbonate concentrates		$21.35	.....

The lead and zinc mines of Wisconsin are in Grant, Iowa, and Lafayette counties and contain the most valuable part of the ore deposits of the upper Mississippi Valley region, a historical review of which is given in the Illinois section of this report in Mineral Resources for 1914. A detailed description of the Wisconsin lead and zinc districts and of the mines in each district to the year 1906 is given by Bain.[7] The development of the mines subsequent to Bain's report and the output of Wisconsin mines have been given in Mineral Resources for 1907 to 1920.

Roasting and electromagnetic separation have been utilized in the district for many years to produce a marketable zinc product. Comparatively few of the concentrating plants are equipped with roasters,

[7] Bain, H. F., Zinc and lead deposits of the upper Mississippi Valley: U. S. Geol. Survey Bull. 294, pp. 81–148, 1906.

but practically all the larger mining interests own or control separating plants.[8] The roasting and separating plants operated in Wisconsin in 1921 were those of the National Zinc Separating Co., at Cuba City, and the Blockhouse Mining Co., at Platteville.

Approximately 24,200 tons of sphalerite concentrates were shipped in 1921 from mines in the upper Mississippi Valley region (Illinois and Wisconsin), and practically all was treated at roasting and separating plants in Wisconsin. The average zinc content of the raw sphalerite concentrates sold in 1921 was 25.3 per cent, and the average price per ton was $8.52; the corresponding content and price for 1917 were 32.8 per cent and $29.48; for 1918, 34.6 per cent and $25.70; for 1919, 35.3 per cent and $21.90; and for 1920, 32.4 per cent and $22.64.

The percentage of concentrates recovered from crude ore is much higher in Wisconsin than in the Joplin region, but the raw zinc concentrates average 21 to 42 per cent less in zinc content. The new concentrating plants are equipped with more tables than formerly, though the concentrates from the tables have a very high iron content, but this can be remedied by roasting.

The crude ore yields from 5 to more than 20 per cent of concentrates. The average recovery in concentrates increased from 6.16 per cent in 1920 to 13.02 per cent in 1921, which was a natural reflection of the decreased quantity of crude ore milled. There were no tailings treated in 1921, for it was not profitable to handle such material when raw zinc concentrates of 25 per cent grade sold for less than $10 a ton.[9] The mining methods are largely determined by the mode of occurrence of the ores, but otherwise are similar to those in vogue in working the pockety ores at Joplin. The milling methods used in the Wisconsin field have been described by Walter Schultz,[10] of the Wisconsin Zinc Co.

The zinc-carbonate ore, which is mined almost entirely in the Highland and Mineral Point districts, is purchased mainly by the Mineral Point Zinc Co. and made into zinc oxide in the plant at Mineral Point, Wis. There was very little production of carbonate ores and no sales in 1921.

The metal content of the raw sphalerite concentrates sold by the mines ranged from 20 to 45 per cent, but in most of the concentrates sold was between 20 and 30 per cent. The zinc content of the roasted sphalerite concentrates shipped ranged from 59 to 60 per cent.

The value of the mine output of lead and zinc in Wisconsin was $426,480, against $4,843,690 in 1920. The lead concentrates sold decreased from 3,526 tons in 1920 to 1,302 tons in 1921, and the sphalerite concentrates sold from 101,987 to 16,450 tons. The metal content of the lead concentrates was 1,675 tons less than in 1920. The recoverable zinc content of the sphalerite and zinc-carbonate concentrates decreased 23,895 tons.

The milling plants were in operation, but few of these plants were working at the end of the year. Very little development work was done and very few new mines were opened. As in all other mining regions, labor was plentiful, though costs of mining and milling did

[8] Deutman, E. G., The roasting and magnetic separation of Wisconsin zinc ores: Eng. and Min. Jour., June 28, 1919, pp. 1107–1111.
[9] Boericke, W. F., The Crahall tailing plant: Eng. and Min. Jour., June 25, 1921, pp. 1065–1066.
[10] Schultz, Walter, Milling Wisconsin lead-zinc ores: Eng. and Min. Jour., July 14, 1917, pp. 82–84.

not appreciably decline, and prices for lead and zinc decreased, so that the small operators suspended work and the larger operators closed nearly all their plants.

The larger mining interests in the Wisconsin field, which include the Mineral Point Zinc Co., Wisconsin Zinc Co., Vinegar Hill Zinc Co., and Frontier Mining Co., had a combined output approximately equal to 52 per cent of all the lead concentrates and 84 per cent of all the zinc concentrates shipped from Wisconsin mines in 1921. Of these larger interests the Vinegar Hill Zinc Co. was the only one that operated several mines throughout 1921, and some of the shipments of ore made by the Mineral Point Zinc Co., Frontier Mining Co., and Wisconsin Zinc Co. consisted of concentrates made in 1920. Mines controlled by the Blockhouse Mining Co., Connecting Link Mining Co., Rodham McQuitty Mining Co., and Zinc Hill Mining Co. contributed nearly all the remainder of the lead and sphalerite shipped. For descriptions of the old mines and concentrating plants on which no essential changes were made during 1921 the reader is referred to Mineral Resources for recent years.

The Livingston district contributed 73 per cent of the sphalerite. The Benton-New Diggings district, which produced more than 47 per cent of the sphalerite shipped from Wisconsin in 1920, produced only 14 per cent in 1921. The producing properties in this district were the Champion, Longhorn, and C. A. Thompson mines of the Wisconsin Zinc Co., the Hoskins and Penna-Benton mines of the Mineral Point Zinc Co., the Fields-Meloy mine of the Vinegar Hill Zinc Co., and the lessees of the Maude Mining Co.

The only producers in the Cuba City district in 1921 were the Connecting Link Mining Co. (two mills) and the Big Dick and Little Dick mines of the Zinc Hill Mining Co.

The Livingston and Mifflin districts shipped 12,008 tons of sphalerite, 19,611 tons less than in 1920. The only large producing mines were the Yewdall and Dale Rundell mines of the Vinegar Hill Zinc Co.

Mines in the Platteville and Potosi districts shipped 438 tons of sphalerite, nearly all of it by the Blockhouse Mining Co.

The production of both galena and sphalerite from mines in the Shullsburg district was much less than in 1920, and considerable quantities of galena and sphalerite were held in bins at the end of 1921. Nearly all the shipments were made by the Rodham McQuitty Mining Co. The only new mill erected in 1921 was that of the Blockhouse Mining Co. on the Goke lease.

QUICKSILVER.

By F. L. Ransome.

STATISTICAL SUMMARY.

Quicksilver produced in the United States in 1921.

State.	Ore treated (short tons).	Quicksilver obtained.		
		Percentage tenor won.	Quantity (flasks of 75 pounds).	Value.
California	16,450	0.59	a3,055	$144,868
Texas, Nevada, Oregon, and Idaho	18,400	.67	3,284	155,727
	34,850	.63	6,339	300,595

a Includes 477 flasks obtained by washing and not considered in calculating percentage tenor.

Average price per flask: San Francisco, $47.42; New York, $45.46; London, £11 3s. 5d.

Number of mines producing, 11.

Decrease in production in 1921 from 1920, 7,053 flasks.

Exports from the United States, 29,501 pounds, or 393 flasks.

Imports into the United States, 795,078 pounds, or 10,601 flasks.

Apparent consumption of quicksilver in the United States (domestic production plus imports minus exports), 16,547 flasks.

INTRODUCTION.

In the report for 1920 it was stated that the output for 1921 was likely to fall below the 7,723 flasks of 1850, the year in which significant production in the United States began. That this view was not unduly pessimistic is shown by the fact that only 6,339 flasks was produced in 1921. This was the smallest output on record. The United States, which was the leading quicksilver-producing country in 1917 and 1918, is now a poor third. In 1921 it produced approximately only one-half as much quicksilver as Spain and one-third as much as Italy. Moreover, both in Italy, which now includes Idria, and in Spain the output was below the average for the years immediately preceding the war.

The average quoted price per flask in San Francisco in 1921 was $47.42, and in New York, $45.46. These prices are much lower than they have been in any other year since 1913 and are approximately the same as in 1908 to 1911, when the annual domestic production was about 20,000 flasks. Apparently only two mines of any importance in the United States had ore of such grade and were in other respects so favorably situated as to make full operation profitable at the prices obtainable in 1921.

The smallness of the domestic production in 1921 is apparently not due, directly at least, to unusually large imports of foreign quicksilver, for the total imports were only 10,601 flasks, considerably less than in 1920 and about the same quantity as in 1919. The apparent domestic consumption (domestic production plus imports minus exports) was only 16,547 flasks, whereas in the years immediately prior to the war it was from 21,000 to 24,000 flasks and in 1918 it was 36,504 flasks.

PRODUCTION.

WORLD'S PRODUCTION.[1]

In the accompanying table are given the best figures available for the world's production of quicksilver in 1917–1920; figures for 1921 are not yet at hand. The foreign figures, generally published in metric tons, are calculated to flasks of 75 pounds net.

As was predicted in the report for 1919, Italy, with a production of 1,401 metric tons, surpassed all other countries in yield of quicksilver in 1920. Of this total, 526 metric tons came from the province of Venezia Giulia, which contains the Idria mine.[2] The yield from both the Monte Amiata district and the Idria mine is still, however, far below the normal output of pre-war years.

The Spanish production was smaller than in 1919, apparently owing mainly to extensive changes made during 1920 in the mining and metallurgical equipment at Almaden.

The most notable decrease in production was that recorded for the United States. The output of this country fell from 36,159 flasks in 1917 to 13,392 flasks in 1920. As indicated above, there was a further large decrease in 1921.

World's production of quicksilver, 1917–1920.

[1 metric ton=29.395 flasks.]

Country.	1917		1918		1919		1920	
	Flasks.	Metric tons.	Flasks.	Metric tons.	Flasks.	Metric tons.	Flasks.	Metric tons.
United States	36,159	1,230.1	32,883	1,118.6	21,415	728.5	13,392	455.6
Spain [a]	25,147	855.5	16,677	567.3	36,055	1,226.6	25,330	861.7
Italy [b]	31,494	1,071.4	30,512	1,038.0	24,839	845.0	41,182	1,401.0
Austria	19,066	[c] 648.6	12,346	[c] 420.0	(d)	(d)	(d)	(d)
Hungary	2,781	[e] 94.6	2,352	[f] 80.0	(g)	(g)	(g)	(g)
Czechoslovakia	.....	.....	.....	.....	2,352	[f] 80.0	2,352	[h] 80.0
Mexico [h]	974	33.1	4,809	163.6	3,496	118.9	2,269	77.2
Other countries [i]	1,000	34.0	1,000	34.0	1,000	34.0	1,500	51.0
	116,621	3,967.3	100,579	3,421.5	89,157	3,033.0	86,025	2,926.5

[a] Estadística minera de España, Madrid.
[b] Riv. servizio min. Roma. For 1920, advance figures furnished by the Italian Ministry of Agriculture through the U. S. Department of State.
[c] Castelli, Gaetano, La mina de mercurio de Idria: Rev. minera, metalúrgica y de ingeniería, Madrid, Aug. 24, 1921.
[d] Output of Idria mine credited to Italy.
[e] Montanistische Rundschau, Wien.
[f] Statistics not available; estimate only.
[g] Deposits now in Czechoslovakia.
[h] Bol. minero, Dept. de Minas, Mexico.
[i] Estimated as flasks and quantity in metric tons calculated therefrom.

[1] For more complete data see pp. 513–564.

[2] It is not entirely clear from the advance figures furnished by the Italian Ministry of Agriculture whether the 1,401 metric tons given above represents the total output from the whole of Italy or merely the output from the pre-war area of the Kingdom. If the output of Venezia Giulia is not included in the 1,401 metric tons, the total Italian production would amount to 1,927 metric tons, which seems to be entirely too large.

DOMESTIC PRODUCTION.

Only 11 mines actually reported production in 1921, although estimates, amounting in all to 60 flasks, have been made for two or three others reported to have been operated on a very small scale. Only 3 mines produced over 100 flasks each, and 2, the Chisos, in Texas, and the New Almaden (Senator), in California, produced over 92 per cent of the whole.

According to reports to the Geological Survey from individual mining companies or mine operators, the output of quicksilver in the United States was 6,339 flasks of 75 pounds each, against 13,392 flasks in 1920 and 21,415 flasks in 1919.

At the average price for the year, $47.42 a flask, based on quotations for domestic quicksilver in San Francisco published weekly in the Mining and Scientific Press, the value of the output in 1921 was $300,595, a decrease of $766,212 from 1920. The producers of 6,267 of the 6,339 flasks gave in their statistical reports the value of their product. On the supposition that this was in general the amount received from sales, it corresponds to an average value of $43.72 a flask, or $3.70 less than the average quotation in San Francisco.

Quicksilver produced in the United States, 1919–1921.

State.	1919		1920		1921	
	Flasks.	Value.	Flasks.	Value.	Flasks.	Value.
California	15,205	$1,372,859	9,849	$784,571	3,055	$144,868
Oregon	435	39,276	24	1,912		
Texas	5,019	453,166	3,436	273,712	3,284	155,727
Nevada	756	68,259	83	6,612		
Idaho						
	21,415	1,933,560	13,392	1,066,807	6,339	300,595

Quicksilver produced in the United States, 1850–1921.

[In flasks of 76.5 pounds to June, 1904; subsequently in flasks of 75 pounds.]

Year.	Flasks.	Average price per flask.	Value.	Year.	Flasks.	Average price per flask.	Value
1850	7,723	$99.45	$768,052	1887	33,825	$42.37	$1,433,334
1851	27,779	66.93	1,859,248	1888	33,250	42.50	1,370,625
1852	20,000	58.33	1,166,600	1889	26,484	45.00	1,191,780
1853	22,284	55.45	1,235,648	1890	22,926	52.50	1,203,615
1854	30,004	55.45	1,663,722	1891	22,904	45.25	1,036,406
1855	33,000	53.55	1,767,150	1892	27,993	40.71	1,139,595
1856	30,000	51.65	1,549,500	1893	30,164	36.75	1,108,527
1857	28,204	48.73	1,374,381	1894	30,416	30.70	933,771
1858	31,000	47.83	1,482,730	1895	36,067	37.04	1,335,922
1859	13,000	63.13	820,690	1896	30,765	34.96	1,075,544
1860	10,000	53.55	535,500	1897	26,691	37.28	995,040
1861	35,000	42.05	1,471,750	1898	31,092	38.23	1,188,647
1862	42,000	36.35	1,526,700	1899	30,454	47.70	1,452,656
1863	40,531	42.08	1,705,544	1900	28,317	44.94	1,272,566
1864	47,489	45.90	2,179,745	1901	29,727	48.46	1,440,570
1865	53,000	45.90	2,432,700	1902	34,291	43.20	1,481,371
1866	46,550	53.13	2,473,202	1903	35,634	45.29	1,613,864
1867	47,000	45.90	2,157,300	1904	35,315	43.50	1,536,203
1868	47,728	45.90	2,190,715	1905	30,534	36.22	1,105,941
1869	33,811	45.90	1,551,925	1906	26,083	39.50	1,030,279
1870	30,077	57.38	1,725,818	1907	21,554	39.60	853,538
1871	31,686	63.10	1,999,387	1908	19,752	44.17	872,446
1872	31,621	65.93	2,084,773	1909	21,075	45.45	957,859
1873	27,642	80.33	2,220,482	1910	20,601	46.51	958,153
1874	27,756	105.18	2,919,376	1911	21,256	46.01	977,989
1875	50,250	84.15	4,228,538	1912	25,064	42.05	1,053,941
1876	72,716	44.00	3,199,504	1913	20,213	40.23	813,171
1877	79,395	37.30	2,961,434	1914	16,548	49.05	811,680
1878	63,880	32.90	2,101,652	1915	21,033	85.80	1,804,631
1879	73,684	29.85	2,199,467	1916	29,932	125.89	3,768,139
1880	59,926	31.00	1,857,706	1917	36,159	105.32	3,808,266
1881	60,851	29.83	1,815,185	1918	32,883	117.50	3,863,752
1882	52,732	28.23	1,488,624	1919	21,415	90.29	1,933,560
1883	46,725	28.75	1,343,344	1920	13,392	79.66	1,066,807
1884	31,913	30.50	973,347	1921	6,339	47.42	300,595
1885	32,073	30.75	986,245				
1886	29,981	35.50	1,064,325		2,379,159	.....	115,872,792

QUANTITY AND TENOR OF ORE MINED AND TREATED.

Very little ore was treated in retorts in 1921, the quantity of quicksilver obtained by this method being less than 150 flasks.

The total quantity of quicksilver ore mined in the United States in 1921, in small part estimated, appears to have been about 33,800 short tons. The ore treated in furnaces amounted to 34,685 short tons, which yielded 5,721 flasks of quicksilver—a rate or 0.62 per cent, or 12.4 pounds of quicksilver to the ton of ore, whereas in 1920 the average yield of furnace ore was 0.45 per cent, or 9 pounds to the ton. This of course does not mean that the available ore was as a whole of better grade than in 1920 but is probably to be accounted for mainly by the fact that some of the larger mines that had been operated on low-grade ore were idle in 1921.

It is estimated that about 165 tons of ore was treated in retorts, which added to the quantity treated in furnaces gives a total of 34,850 tons, of an average won tenor of 0.63 per cent of quicksilver. At New Almaden 477 flasks was recovered by hand washing material from beneath old furnaces and condensers. The quantity of such material handled was not recorded.

So far as known, furnaces were in operation in 1921 only in California and Texas. The average tenor of the ore treated in furnaces in California was 0.52 per cent; in Texas, 0.65 per cent.

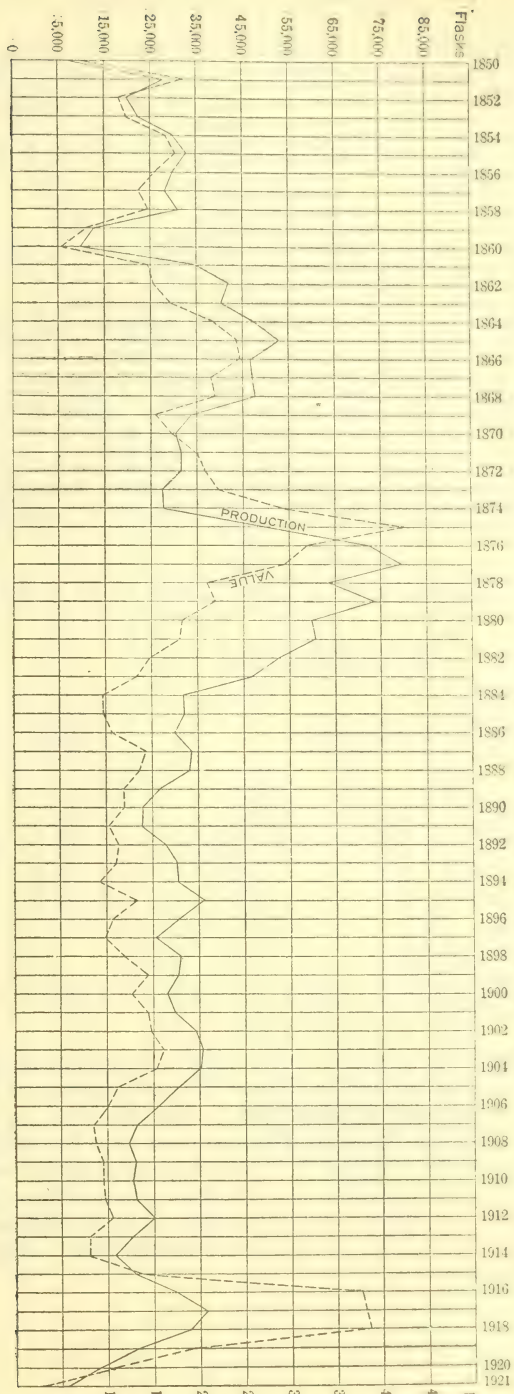

FIGURE 7.—Diagram showing quantity and value of quicksilver produced in the United States from 1850 to 1921, inclusive.

METHODS OF PRODUCTION.

The ores of quicksilver, unlike those of most metals that are won by smelting, are without exception in this country treated at the mines, and the liquid metal is shipped as a finished commercial product.

Methods of treatment have been briefly described in the reports for 1917, 1918, and 1919.

PRICES.

The average domestic price of quicksilver was lower in 1921 than for any other year since 1913.

The prices given in the following table have been obtained by averaging the weekly quotations published in the Mining Journal for London, the Engineering and Mining Journal for New York, and the Mining and Scientific Press for San Francisco, the primary domestic market. As the figures prior to 1913, however, are not complete in the Mining and Scientific Press, those for 1910–1912 have been taken from the Engineering and Mining Journal. Obviously, the figures given in this table, being annual averages, may differ considerably from the price actually quoted or obtained on a particular date.

Average yearly prices of quicksilver in the United States and the United Kingdom, 1910–1921.

[Per flask of 75 pounds.]

Year.	San Francisco[a] (domestic).	New York.[b]	London.[c]			Year.	San Francisco[a] (domestic).	New York.[b]	London.[c]		
			£	s.	d.				£	s.	d.
1910	$46.51	$47.06	8	16	0	1916	$125.89	$125.49	17	2	10
1911	46.01	46.54	8	4	11	1917	105.32	106.30	22	4	3
1912	42.05	42.46	8	2	10	1918	117.50	123.47		[e]	
1913	40.23	39.54	7	9	2	1919	90.29	92.15	20	9	5½
1914	49.05	48.31	[d]7	15	0	1920	79.66	81.12	20	14	9
1915	85.80	87.01	14	10	8	1921	47.42	45.46	11	3	5

[a] Min. and Sci. Press, San Francisco.
[b] Eng. and Min. Jour., New York.
[c] Min. Jour. (London).
[d] Metal exchange closed about three months after outbreak of war. Average based on 37 weeks only.
[e] Quoted as "nominal" only.

Although San Francisco is commonly referred to as the "primary market" for quicksilver in the United States, from the fact that the greater part of this metal produced in the country comes from the Pacific coast and goes through the hands of San Francisco firms, yet it should be noted that that city is not a market in the same sense as New York. Most of the quicksilver that passes nominally through San Francisco is handled on commission and is sold in New York, which consequently is the great distributing point of quicksilver to the actual customers.

Prices of domestic quicksilver at San Francisco, 1919–1921.

[Per flask of 75 pounds.]

Month.	1919	1920	1921	Month.	1919	1920	1921
January	$103.75	$89.00	$50.00	July	$100.00	$88.00	$47.75
February	90.00	81.00	48.75	August	103.00	85.00	47.50
March	72.80	87.00	45.88	September	102.60	75.00	47.50
April	73.12	100.00	46.00	October	86.00	71.00	46.25
May	84.80	87.00	50.00	November	78.00	56.00	40.40
June	94.40	85.00	49.50	December	95.00	52.50	49.50

IMPORTS AND EXPORTS.

The import duty on quicksilver from 1890 to 1895 was 10 cents a pound; from 1895 to 1913 it was 7 cents. The Underwood tariff bill, enacted in 1913 and still in force, made the duty 10 per cent ad valorem. The proposed tariff bill as reported to the Senate April 11, 1922, provides a duty of 25 cents a pound on metallic quicksilver, equivalent to $18.75 a flask.

In the following tables [2] are given imports of quicksilver for domestic consumption, total annual exports, and annual exports by countries. The figures in pounds have been calculated to the approximate equivalent in metric tons and in flasks.

Quicksilver imported and entered for consumption in the United States, 1912–1921.

Year.	Pounds.	Metric tons.	Flasks.	Value.
1912	82,706	37.52	1,103	$39,920
1913	171,653	77.86	2,289	75,361
1914	614,869	278.90	8,198	271,984
1915	421,884	191.37	5,625	282,752
1916	424,396	192.50	5,659	515,919
1917	390,494	177.13	5,207	448,032
1918	503,907	228.57	6,719	533,622
1919	797,613	361.79	10,635	791,226
1920	1,062,647	482.01	14,169	971,510
1921	795,078	360.64	10,601	457,993

Quicksilver exported from the United States, 1912–1921.

Year.	Pounds.	Metric tons.	Flasks.	Value.
1912	23,283	10.56	310	$13,360
1913	85,521	38.79	1,140	43,574
1914	108,426	49.18	1,446	70,753
1915	252,852	114.69	3,372	225,509
1916	666,027	302.11	8,880	670,475
1917	808,336	366.66	10,778	998,470
1918	232,346	105.39	3,098	338,620
1919	683,004	309.80	9,107	817,328
1920	116,493	52.84	1,553	129,993
1921	29,501	13.38	393	18,869

[2] Compiled by J. A. Dorsey, of the U. S. Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Domestic quicksilver exported from the United States, 1920–21, by countries.

Country.	1920		1921	
	Pounds.	Value.	Pounds.	Value.
North America:				
Canada	33,743	$38,459	11,102	$6,955
Mexico	782	962	1,169	818
Newfoundland and Labrador	75	100	.....	.....
Central America:				
Costa Rica	75	88	339	188
Guatemala	25	40	150	94
Honduras	.....	.....	150	105
Nicaragua	1,203	1,483	.....	.....
Panama	60	90	47	44
Salvador	450	540	75	48
West Indies:				
Cuba	1,449	1,596	150	92
Dominican Republic	.....	.....	10	11
Haiti	10	19	.....	.....
South America:				
Argentina	1,005	1,235	.....	.....
Brazil	300	384	100	50
Chile	1,157	1,481	.....	.....
Colombia	766	947	1,830	1,383
Ecuador	70	85	.....	.....
Guiana—French	150	186	.....	.....
Peru	1,275	1,501	716	529
Venezuela	336	378	.....	.....
Asia:				
China	435	513	10	10
Chosen (Korea)	1,411	1,454	1,578	960
Hongkong	75	88	.....	.....
India (British)	3,675	4,508	.....	.....
Japan	66,000	71,475	11,250	6,975
Russia in Asia	150	200	.....	.....
East Indies—Dutch	675	860	225	142
Oceania:				
Australia	176	170	.....	.....
Philippine Islands	965	1,151	600	465
	116,493	129,993	29,501	18,869

USES OF QUICKSILVER.

The uses of quicksilver, which are exceedingly varied, have been rather fully described in previous reports, which are still available for distribution.

SUPPLIES.

Supplies of quicksilver in the United States, 1913–1921.

Year.	Production.		Imports.		Exports.		Apparent consumption.	
	Flasks.	Value.	Flasks.	Value.	Flasks.	Value.	Flasks.	Value.
1913	20,213	$813,171	2,289	$75,361	1,140	$43,574	21,362	$844,958
1914	16,548	811,680	8,198	271,984	1,446	70,753	23,300	1,012,911
1915	21,033	1,804,631	5,625	282,752	3,372	225,509	23,286	1,861,874
1916	29,932	3,768,139	5,659	515,919	8,880	670,475	26,711	3,613,583
1917	36,159	3,808,266	5,207	448,032	10,778	998,470	30,588	3,257,828
1918	32,883	3,863,752	6,719	533,622	3,098	338,620	36,504	4,058,754
1919	21,415	1,933,560	10,635	791,226	9,107	817,328	22,943	1,907,458
1920	13,392	1,066,807	14,169	971,510	1,553	129,993	26,008	1,908,324
1921	6,339	300,595	10,601	457,993	393	18,869	16,547	739,719

QUICKSILVER MINING INDUSTRY, BY STATES.

Alaska.—Two quicksilver deposits were being developed in Alaska in 1921. One is at the Parks mine, on the lower Kuskokwim, and the other at the Thrift mine, 20 miles southwest of Iditarod. A small quantity of quicksilver was produced at the Thrift mine but was not shipped out of the Territory.[3]

California.—In 1921 the only important mine that continued to be worked on a normal scale in California was the Senator mine of the New Almaden Co. (Inc.). The Cloverdale produced less than 300 flasks from the operations of lessees.

The total production of the State was 3,055 flasks, valued at $144,868. Of this total, 2,549 flasks were obtained from furnaces, 29 flasks from retorts, and 477 flasks by hand washing of material from the sites of demolished reduction plants at New Almaden. The output in 1920 was 9,849 flasks, valued at $784,571. There was in 1921, therefore, a decrease in quantity of 69 per cent and in value of 82 per cent, as compared with 1920. California produced 48 per cent of the total quicksilver output of the country in 1921, as compared with 73.5 per cent in 1920.

Quicksilver produced in California, 1850–1921.

Year.	Flasks of 75 pounds.	Price per flask.	Value.	Year.	Flasks of 75 pounds.	Price per flask.	Value.
1850–1910	2,085,308	.....	$93,543,501	1917	23,938	$105.32	$2,521,151
1911	18,860	$46.01	867,749	1918	22,664	117.50	2,663,020
1912	20,524	42.05	863,034	1919	15,205	90.29	1,372,859
1913	15,591	40.23	627,228	1920	9,849	79.66	784,571
1914	11,303	49.05	554,414	1921	3,055	47.42	144,868
1915	14,283	85.80	1,225,481				
1916	21,045	125.89	2,649,355		2,261,625	.....	107,817,231

In San Benito County the New Idria mine, which for many years has been the most productive quicksilver mine in the United States, was idle, and, so far as known, no quicksilver was produced in this, formerly the leading county in the State. Its place was taken in 1921 by Santa Clara County, in which is the Senator mine.

Only 7 operators reported production in California in 1921, as against 11 in 1920. At four localities the metal was obtained by furnace reduction, but at only one locality does operation appear to have been continuous throughout the year. At three localities very small quantities of quicksilver were obtained by retorting, and at New Almaden 477 flasks of quicksilver was recovered, by washing, from an unrecorded quantity of material.

In Lake County a very small production was made from the Helen and Wall Street mines, but no new ore was raised. In Santa Clara County the Senator mine was in operation, but the small yield from the New Guadalupe mine came from ore mined in 1920. In Sonoma County some ore was mined and treated by contract work at the Cloverdale mine. Less than 20 flasks was obtained from minor operations in Santa Barbara and Trinity counties.

[3] Brooks, A. H., advance statement on mining in Alaska in 1921 (U. S. Geol. Survey press notice).

Idaho.—Some development work was in progress in 1921 in the Yellow Pine district, Valley County, Idaho. The United Mercury Mines Co. effected a consolidation in ownership of over 100 claims formerly held by the Idaho Quicksilver Co., the Monumental Mercury Mines Co., and other companies in the Yellow Pine district.

Nevada.—The only production reported from Nevada was from the Pilot Mountains, east of Mina, in Mineral County. Three or more operators are reported to have been active there in a small way, but returns were received from only one of them. It is estimated that about 100 flasks of quicksilver was obtained from this locality in 1921.

Oregon.—In Oregon the War Eagle Mining Co., at what was formerly known as the Rainier mine, in Jackson County, had completed a 25-ton Scott furnace in 1920 and is reported to have had it in operation for a very short time early in the spring of 1921. A small quantity of quicksilver was produced.

Texas.—The Chisos mine, in the Terlingua district, Brewster County, Tex., produced the only quicksilver recorded from Texas in 1921. Its output was larger than that of any other mine in the country, although it yielded less than during any one of the six years preceding. Some prospecting was done at the Mariscal mine, south of McKinney Springs, but the mines at Study Butte and the Mariposa mine, west of Terlingua, were idle.

NOTES ON FOREIGN QUICKSILVER DEPOSITS.

Very little news concerning foreign quicksilver deposits in 1921 is available. At Almaden, Spain, the year has been marked by extensive improvements in hoisting equipment and in the metallurgical plant. Steps were taken to increase the efficiency of the labor employed. The mine has been deepened so as to make available an additional block of ore between the 12th and 13th levels, and considerable prospecting has been undertaken with a view to enlarging the area of productive ground.

On December 31, 1921, the contract through which the Rothschilds of London had been acting as selling agents for Almaden quicksilver expired, and the Spanish Government is now disposing of its product directly. The mine, it is understood, can make a substantial profit with quicksilver selling at £8 a flask.

In Mexico, notwithstanding the low price of quicksilver, considerable activity is reported. According to Mr. Louis Banigan [1] an American syndicate, organized by him, is reopening the old Santa Rosa quicksilver mines, in the State of Morelos, about 18 miles by trail from Cuernavaca. These were among the first quicksilver deposits worked in New Spain and were thrice closed by royal decree between 1700 and 1750, because of their competition with the crown monopoly at Almaden. On one of these occasions the destruction of the mines is said to have been ordered, and some of the workings were blocked or permitted to cave. The ore is reported to average 1 per cent quicksilver, with rich shoots that contain 5 per cent or more. A new 5-ton Scott furnace is under construction, and it is intended to repair two 20-ton furnaces of the same type, which were completed in 1911, only 30 days before the revolution began in Morelos. They

[1] Letter to the Director of the U. S. Geological Survey, May 4, 1922.

were considerably damaged by the Zapata revolutionists. During the 30 days of operation in 1911 they produced 200 flasks of quicksilver.

A large American mining and smelting company is reported to be interested in quicksilver deposits in the Guadalcazar district, in the State of Potosi. One of these is at the well-known Trinidad mine, which, it is stated, is again in good ore, running as high as 7 per cent. This mine has large dumps, estimated to contain from 0.75 to 1.0 per cent of quicksilver.

The Huitzuco mines, in Guerrero, once large producers, are reported to be idle. The workings extend to a depth of 1,000 feet, and there is a great deal of water on the bottom level.

RECENT PUBLICATIONS ON QUICKSILVER.

Compiled by Isabel P. Evans.

Austria, Ministerium für offentliche Arbeiten, Statistik des Bergbaus in Österreich für das Jahr 1916: Lief. 1, Die Bergwerksproduktion (Quecksilber), pp. 4, 8, 9, Wien, 1920. Discusses quicksilver and quicksilver ore in Carinthia, Tyrol, Carniola, and Dalmatia and gives table of production in the whole of Austria from 1912 to 1916.

Baker, C. L., General geology of the Catorce mining district, San Luis Potosi (mercury sulphides): Eng. and Min. Jour., vol. 112, pp. 488–489, Sept. 24, 1921 (in part). Mercury sulphides are found south of the main district.

Brooks, A. H., The Alaskan mining industry in 1920 (quicksilver): U. S. Geol. Survey Bull. 722, pp. 23–24, 1921. The cinnabar-bearing lode discovered in 1919 in the headwater region of Iditarod River, though far too small to be of value, gives hope of finding commercially valuable deposits, especially as but little prospecting has been done for cinnabar.

——— Mineral resources of Alaska, 1919 (quicksilver): U. S. Geol. Survey Bull. 714, 39–40, 1921. The Parks property, on the north bank of Kuskokwim River about 330 miles from its mouth, is the only developed quicksilver mine in Alaska. It is probable that the lower Kuskokwim will continue to produce, but there are no indications that quicksilver mining will become an important industry in Alaska.

Boletín Minero, Departamento de Minas (Mexico), Cuadro comparativo de la producción de algunos metales industriales durante los meses de enero á abril de 1920 y 1921 (mercurio): Vol. 11, p. 857, June, 1921. In 1920 the production of mercury for these four months was 30,022 kilos; in 1921, 10,578 kilos.

Buisson, Arthur, The production of copper, gold, lead, nickel, silver, zinc, and other metals in Canada during the calendar year 1919 (mercury): Canada Dept. Mines, Mines Branch, pp. 44–45, 1921. Résumé of former reports. No new localities for mercury discovered.

Burcham, W. D., Quicksilver: Mineral Industry, vol. 29, pp. 607–614, 1921. Reviews the quicksilver industry in the United States from 1906 to 1920 and in Spain from 1908 to 1919 and discusses the occurrence and production of quicksilver in Idria and the Monte Amiata district of Tuscany, Italy.

California State Mining Bureau, Mining in California in 1920 (quicksilver): State Mineralogist Rept. 17, pp. 9, 47, 60, 70, 77, 80, 147, 160, 174, 207, 246, 250, 255, 314, 356, 385, 389, 498, 536, 1921. "Quicksilver production in California during recent years has come from 12 counties, all but three of which are in the San Francisco district, and the three in question (Kern, Siskiyou, and Trinity) are relatively unimportant."

Castelli, Gaetano, La mina de mercurio de Idria: Rev. min., metal. y de ingeniería, año 72, No. 2797, pp. 453–455, Madrid, 1921. A good account of the Idria mine, with a table of production.

Chemical Engineering and Mining Review, Cinnabar in New Zealand: Vol. 13, p. 205, March 5, 1921. The cinnabar in the quicksilver mine at Puhipuhi, 95 miles north of Auckland, is disseminated through fractured chert for an unknown distance from the hanging wall. Up to the present the mine has produced 395 flasks of 75 pounds.

Cockfield, W. E., Sixtymile and Ladue Rivers area, Yukon (cinnabar): Canada Geol. Survey Mem. 123, p. 52, 1921. Cinnabar, as angular grains and fragments,

was found in sluice boxes on Sixtymile River near the mouth of Miller Creek. The writer advises careful search for it around Miller Creek in the Tertiary volcanic rocks.

Cloos, H., and Meister, E., Bau und Bodenschätze Osteuropas (Quecksilber): Osteuropa Inst. in Breslau Quellen u. Studien, Abt. 3, Heft 2, pp. 50, 51, 94, 140, 1921. Quicksilver is reported as occurring in the Donetz district, Ukrainia; in the Ural Mountains at Beresowsk, Miass, and Bogoslowsk; and in the Caucasus Mountains at Krauth, Chpeck, Ruchun, and Gepse, in the Daghestan district. The production in the Caucasus for 1906 was about 1,000 tons of ore (50,000 poods) averaging from 0.58 to 59.2 per cent of mercury.

De Kalb, Courtenay, The Almaden quicksilver mine: Econ. Geology, vol. 16, pp. 301–312, June–July and August, 1921. The quicksilver at Almaden occurs in three distinct lodes which are nearly parallel in the central part of the mine, strike nearly east and west, and stand nearly vertical. The average mercury content of the ore is 8 per cent and, approximately, the mercury in the ore reserves is about 33,000,000 pounds.

Doelter, C., Ueber einige Erzlagerstätten Serbiens (Quecksilber): Zeitschr. prakt. Geologie, Jahrg. 25, Heft 9, p. 149, 1917. Describes the quicksilver deposit near Ripani, south of Avala Mountain, Serbia.

Engineering and Mining Journal, [Mineral production of Mexico] (mercury): Vol. 111, p. 185, Jan. 22, 1921. The production of mercury in Mexico during the first six months of 1920 was 42,505 kilograms. The total value was $220,218.

——— Sharp decline in quicksilver production in 1920: Vol. 111, p. 543, March 26, 1921. Quoted from preliminary figures showing the production of quicksilver in the United States in 1920, given by the United States Geological Survey.

——— Production of metals in Mexico during 1920 (mercury): Vol. 111, p. 1020, June 18, 1921. The mercury presented for export and the total production were the same—75,748,400 kilograms.

Ferrar, H. T., and Cropp, W. H., Whangarei and Bay of Islands subdivision (cinnabar): New Zealand Mines Dept., Geol. Survey Branch, Fifteenth Ann. Rept., new ser., p. 8, 1921. The cinnabar mines at Puhipuhi, North Auckland, are being devoloped but slowly.

Franke, E., Mitteilungen über einige Erzlagerstätten in Kleinasien: Metall u. Erz, Band 15, pp. 348–360, 1918. Near Eskiköj, 17 kilometers north of Uschak, in Turkey in Asia, occurs in two places a weak impregnation of cinnabar. Somewhat more important is the deposit at Baltaly, 10 kilometers east of Eskiköj, in a porous siliceous flint whose cavities are entirely filled with cinnabar.

Gastelumendi, A. G., Huancavelica como región productora de mercurio: Perú Cong. nac. indust. minería Anales, vol. 2, pt. 2, pp. 31–69, 1 map, 1921. The mercury occurs as cinnabar, generally mingled with bituminous materials, sulphides of arsenic, iron, and sometimes zinc and lead.

Girard, G., Mineral wealth of Tonkin (mercury): Far East. Rev., vol. 17, pp. 525, 527, August,1921. On the chart of the mines of Tonkin, mercury mines are located at Khao Loc, in northern Tonkin, near Rivière Claire.

Gould, H. W., The Almaden quicksilver mine in Spain: Min. and Sci. Press, vol. 122, pp. 567–569, illus., April 23, 1921. The three veins of cinnabar, which occurs as a replacement deposit in quartzite, stand almost vertical and average from 8 to 14 meters in width. In 1917, the latest year for which a report has been published, the total ore treated was 13,166 metric tons, yielding 911.7 tons of quicksilver, an extraction of 6.93 per cent.

Hall, A. L., The geology of the Barberton gold mining district (cinnabar): South Africa Geol. Survey Mem. 9. pp. 238, 312, 1918. Cinnabar occurs on lots 56 and 58, about 15 miles southwest of Hectorspruit station and 1 mile due north of the Sterkspruit police post. It occurs in scattered pockets, and there is no indication of any definite lode.

Hamilton, Fletcher, Quicksilver in California: Eng. and Min. Jour., vol. 111, p. 148, Jan. 22, 1921. "The domestic quicksilver industry is in danger of complete extinction if not soon given adequate protection against foreign importations."

——— California mineral production for 1920 (quicksilver): California State Min. Bur. Bull. 90, pp. 71–76, August, 1921. Quicksilver was produced in 13 counties in 1920, with a decrease in number of flasks and value compared with 1919. The 1920 yield is the smallest number of flasks since 1860.

Häusler, ——, Quecksilbervorkommen von Neu-Seeland: Zeitschr. prakt. Geologie, Jahrg. 29, Heft 10, p. 158, October, 1921. Cinnabar is found in New Zealand in Ohacawei, near Lake Omapere, Bay of Islands; in the Puhipuhi district, North

Auckland; in Otago, near Nevis, Nokowai, Waipori, and Waitahuna. In Makaytown, near Karangahake, andesite rocks also contain cinnabar ore.

IDAHO INSPECTOR OF MINES, Mining industry of Idaho: Twenty-second Ann. Rept., for 1920, p. 9, 1921. In the Yellow Pine quicksilver district of central Idaho during the year 1,500 feet of tunnel prospecting was done on half a dozen properties.

JOLEAUD, L., Les richesses minérales de l'Afrique du Nord (Maroc, Algérie, Tunisie) (mercure): Soc. encour. ind. nat. Bull., 119e année, vol. 132, No. 4, p. 423, 1920. Mercury occurs as cinnabar in the Aures Mountains of Algeria and also along the coast of Algeria between Philippeville and Bône.

KELLOGG, A. E., Quicksilver: Min. and Sci. Press, vol. 123, pp. 254–255, Aug. 20, 1921. Advocates a high tariff to protect American production and competition in the United States to reduce the prices.

MCINNES, WILLIAM, Report of the Director (mercury): Canada Geol. Survey Summary Rept., 1919, pt. A, p. 2A, 1921. A geologic and mineralogic survey of the west coast of Vancouver Island reports a mercury deposit near the Sechart whaling station, on Barkley Sound, which would justify thorough prospecting.

METALLGESELLSCHAFT (Frankfurt am Main), Statistische Zusammenstellungen über Aluminium, Blei, Kupfer, Nickel, Quecksilber, Silber, Zink, und Zinn (quicksilver): Jahrg. 22, 1911–1920, p. 9, December, 1921. Gives the production and value of quicksilver from 1911 to 1920 in Spain, Italy, Austria-Hungary, United States, and Mexico.

MIELEITNER, KARL, Die technisch wichtigen Mineralstoffe (Quecksilber), pp. 118–122, 1919. Gives the geologic relations and mineral associations of quicksilver ores in different parts of the world.

MINING AND SCIENTIFIC PRESS, The mining of quicksilver: Vol. 122, pp. 553–554, Apr. 23, 1921. As quicksilver is such an important asset in time of war, in view of the greatly decreased production, a choice of two courses is suggested, a high protective tariff, or the purchase and storing of a quantity of quicksilver by the Government to have a reserve sufficient for two years' need.

MINING JOURNAL (London), Mining and the Austrian Succession States (quicksilver): Vol. 135, p. 914, Dec. 10, 1921. The Idria quicksilver mines in the Carniola, halfway between Gorizia and Laibach, had an annual output of about 600 tons of metal shortly before the war. There are also a large number of other quicksilver producing properties, of which the Avala mines are the best known.

MINISTERIO DE FOMENTO, AGRICULTURA, MINAS Y MONTES (Spain), Estadística minera de España, formada y publicada por el Consejo de Mineria (quicksilver): Año 1920, pp. 471–488, 503, diagrams, Madrid, 1921. Gives tabulated returns of production of quicksilver from 1911 to 1920.

NEUMANN, BERNHARD, Zur Geschichte der Quecksilbergewinnung: Zeitschr. angew. Chemie, Aufsatzteil, Jahrg. 34, p. 161, Apr. 26, 1921. Reviews briefly writers on quicksilver and different methods of quicksilver distillation.

OREGON BUREAU OF MINES AND GEOLOGY, Development of quicksilver deposits: Comm. to Governor and 31st Gen. Assembly Rept., p. 18, [1921]. Assistance given by engineers of the bureau staff includes information on economic geology of the deposit, surveying and mapping, sampling, ore testing, outlines of development, and advice as to reduction plants.

PARDEE, J. T., Deposits of manganese ore in Montana, Utah, Oregon, and Washington (cinnabar): U. S. Geol. Survey Bull. 725, p. 214, 1921. A small quantity of cinnabar has been found a short distance northwest of Lake Creek post office, Oreg., but it has not been shown to be of economic value.

PATTY, E. N., and GLOVER, S. L., The mineral resources of Washington (quicksilver): Washington Geol. Survey Bull. 21, p. 86, 1921. Deposits of cinnabar of low grade occur near Morton, Lewis County; in Kittitas County; near Hawkins Mountain; in sec. 8, T. 22 N., R. 16 E.; in Chelan County near Squaw Mountain; and at a point near Orondo.

RANGEL, MANUEL, and TERRONES, ALBERTO, Mineral resources of Durango, Mexico (cinnabar): Eng. and Min. Jour., vol. 112, pp. 168–174, illus., July 30, 1921. Gives eight localities in which cinnabar occurs. "At Los Remedios and Cucuyame mines, in the Tamazula district, there are some rich cinnabar deposits, but the location is far from rail" (p. 171).

RANSOME, F. L., Quicksilver in 1919: U. S. Geol. Survey Mineral Resources, 1919, pt. 1, pp. 149–180, 1921. Quicksilver has continued to decline in mining activity and production even more than in 1918. The higher grade of the ore treated in furnaces was caused by the dropping out of producers of low-grade ore. No new deposits of importance were found in 1919.

——— The ore of the Almadén mine: Econ. Geology, vol. 16, pp. 313–321, figs. 21–24, June–July and August, 1921. Discusses the general geologic relations and mode of occurrence of the quicksilver ore at Almaden and adds "The deposit, therefore, is not to be classed, as it sometimes has been, with those in which cinnabar occurs as an impregnation of porous sandstone" (p. 321).

Revista minera, metalúrgica y de ingeniería, Real decreto autorizando al Consejo de administración de las minas de Almadén para vender el azogue que se produzca en dichas minas: Año 72, pp. 675–677, Dec. 24, 1921. Gives conditions governing the sale of quicksilver from the Almaden mine and authorizes appointments of assistant professors and engineers in the school and laboratory.

Schuette, C. N., The sampling and estimation of quicksilver ores: Min. and Sci. Press, vol. 122, pp. 293–295, 5 figs., Feb. 26, 1921. Panning, though a crude method of sampling, has suprisingly accurate results when done by experienced men and is considered legitimate all the world over. Necessary requisites for sampling a quicksilver mine are knowledge of geology and familiarity with quicksilver ore and the mining of it.

Schulze, Alfred, Die physikalischen Eigenschaften des Quecksilbers: Zeitschr. Metallkunde, vol. 13, pp. 105–113, 138–148, 7 figs., Mar. 1 and 15, 1921. Gives the mechanical, thermal, electrical, magnetic, and optical properties of quicksilver.

Shannon, E. V., Mineralogy of some black sands from Idaho, with a description of the methods used for their study (cinnabar): U. S. Nat. Mus. Proc., vol. 60, art. 3, p. 29, 1921. Cinnabar, deep red with a grayish metallic cast, occurs sparingly in a sand from Pierce City and also in the polycrase sand from Centerville.

Trythall, Frank, Quicksilver mining in China: Min. Mag. (London), vol. 24, pp. 187–189, March, 1921. Describes the mining of quicksilver in the Toon-Yen prefecture, Kweichow Province, South China. There are two varieties of cinnabar. One is a bright transparent red; the other a dark opaque red variety with which antimony is almost invariably associated in small quantities. Pyrites is entirely absent.

United States Geological Survey, World atlas of commercial geology, Part I, Distribution of mineral production (mercury), pp. 59–60, pls. 57–62, 64, 1921. A summary of the uses, the mineralogic, geographic, and geologic occurrence of mercury, the metallurgic treatment of the ores, and the world's production from 1912 to 1917. The geographic distribution of mercury can be seen at a glance on the plates named.

Wittich, Ernst, Über das Vorkommen von Quecksilbersulfiden in Sanden der Goldseifen bei Guadalcázar, San Luis Potosí, Mexiko: Zeitschr. prakt. Geologie, Jahrg. 29, Heft 6, pp. 91–93, June, 1921. Mercury sulphides, chiefly cinnabar, metacinnabarite, and guadalcazarite, have recently been found in placers in industrially workable quantities in the Guadalcazar Valley.

——— La geología de la región minera de Guadalcázar, S. L. P. (mercury): Bol. minero, vol. 12, pp. 661–677, illus., 2 geol. profiles, Mexico, December, 1921. The cinnabar in Guadalcazar is in the form of well-defined crystals and is the richest quicksilver deposit in the Republic of Mexico. A somewhat rare local variety, "guadalcazarita," is black as iron in color and contains sulphur, selenium, and zinc.

Wray, D. A., The geology and mineral resources of the Serb-Croat-Slovene State, being the report of the geologist attached to the British Economic Mission to Serbia (mercury): [Great Britain] Dept. Overseas Trade, Ref. F. E. 383, pp. 54–57, 1921. The most important mercury mine in this region is at Idria. States the annual output from the Idria mines from 1914 to 1918. Gives a number of localities at which mercury has been mined but whose mines are now abandoned.

Young, G. J., California (quicksilver): Eng. and Min. Jour., vol. 111, pp. 166–167, Jan. 22, 1921. A hopeful word for quicksilver in 1921. Believes that the prospecting and development that was accomplished in 1920 should bring good results in the coming year.

ANTIMONY.

By Frank C. Schrader.

THE ANTIMONY SITUATION.[1]

The antimony market in 1921 was very unsatisfactory. In the general downward movement antimony has fallen more than any other metal. At the beginning of 1921 the price of antimony was 30 per cent below that of the pre-war average and below the cost of production. The decline is attributed to slackness of the consuming trade, large war stocks, and the decline in price of silver.

The average quoted price of antimony in 1921 was 4.96 cents a pound, only 58.42 per cent of the price in 1920 (8.49 cents). The highest price, 6 cents, was reached in March, and the lowest price ever recorded, 4.45 cents, was reached in September. From the strong opening of 5¼ cents in January the price rose to 5½ cents toward the end of that month, but soon declined to 5¼ cents and remained at approximately that figure through February and early March, partly because of the new low record in silver and the heavy war stocks thrown on the market. Toward the middle of March it suddenly rose to 6 cents, the highest price of the year, it is said because of an expectation of increase in import duties. Owing to continued large shipments arriving from the orient, notably China, with ample supplies already on hand, the price soon began to fall and declined almost steadily, with the result that the average price for April and May was approximately 5⅛ cents, June 5 cents, July 4¾ cents, August 4.6 cents, and September 4.55 cents. In October the price rose to 5¼ cents with the market strong. In November it steadily declined. Throughout December with the market dull it remained at 4½ cents.

USES AND SUBSTITUTES.

Metallic antimony is used chiefly in alloys with other metals, as in type metal, babbitt or bearing metal, Britannia or white metal, and antimonial or hard lead. The antimony oxides are used for making white enamel, and the oxides and sulphides as coloring agents and paint pigments.

New uses for antimony are gradually being found. The field of use for the compounds, especially the oxides in paint, is rapidly widening and seems to hold great promise—the result chiefly of the researches of Cookson & Co.[2] in England, whose chief product resulting from this work is a pure-white antimony oxide known by the trade name "Timonex." The United States uses yearly about 2,000

[1] For a general discussion of the subject, the reader is referred to the report in Mineral Resources for 1919.
[2] Paint, Oil, and Chem. Rev., vol. 72, No. 4, p. 10, July 27, 1921; vol. 73, No. 2. Jan. 11, 1922; No. 3, Jan. 18, 1922.

tons of the white oxides and 1,200 tons of the sulphides, including vermilion and other colors.

Of the ten or more known substitutes for antimony the best recently found is a combination of calcium and barium, said to be extensively used with excellent results by the United Lead Co. in the hardening of lead.[3]

DOMESTIC PRODUCTION.

The United States in 1915–1918 produced 10,750 short tons of antimony ore containing 4,310 tons of metal. There has been no production of ore since 1918.

The metallic antimony produced at smelters in the United States in 1917 and 1918 was 385 short tons from domestic ores and 4,672 tons from foreign ores. A small quantity was produced in 1919 and 1920, but the Geological Survey is not at liberty to publish the figures. There was no production in 1921.

SMELTER PRODUCTION OF ANTIMONIAL LEAD.

By-product antimonial lead produced in the United States from both foreign and domestic ores, 1917–1921.

Year.	Short tons.	Antimony content.	
		Short tons.	Value.[a]
1917	18,646	2,759	$1,142,226
1918	18,570	2,566	646,632
1919	13,874	1,943	318,652
1920	12,535	2,033	345,203
1921	10,064	1,589	157,629

[a] Calculated on basis of average yearly price for ordinary brands of antimony as given by Eng. and Min. Jour.

RECOVERY OF SECONDARY ANTIMONY.

During 1921, 4,720 short tons of antimony was recovered from old alloys, scrap, and dross. Practically all of this was recovered in the form of alloys, not as metallic antimony.

Antimony content of secondary alloys recovered from old alloys, scrap, and dross, 1917–1921.

Year.	Short tons.	Value.[a]
1917	4,961	$2,061,700
1918	5,226	1,317,000
1919	4,399	717,900
1920	5,600	938,560
1921	4,720	464,400

[a] Values calculated at average yearly price for ordinary brands of antimony.

IMPORTS AND EXPORTS.

The accompanying statistics of imports are compiled from the records of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce. The imports are reported as (1) imports for consumption, including merchandise entered for immediate consumption or withdrawn from bonded warehouses for consumption, and (2) total or general imports. Only general imports are listed by countries of origin.

[3] Chem. and Met. Eng., Dec. 28, 1921, p. 1181; Min. Mag. (London), vol. 26, p. 127, 1922.

Antimony imported and entered for consumption in the United States, 1917–1921.

Year.	Antimony ore.[a]			Liquated antimony sulphide.[b]		Metallic antimony.[c]		Antimony oxides and other compounds.[d]	
	Short tons.	Antimony content.		Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
		Short tons.	Value.						
1917	10,083	5,832	$1,006,884	796	$128,660	11,286	$2,829,159	10	$5,368
1918	3,363	1,425	177,731	833	113,258	14,011	3,065,619	18	11,904
1919	993	409	54,477	278	19,202	7,159	1,021,587	126	9,501
1920	1,709	682	70,285	1,375	123,902	9,817	1,216,376	298	25,260
1921	213	98	11,682	353	17,577	10,130	784,146	154	15,558

[a] Classified in tariff classification as "Antimony ore and stibnite containing antimony."
[b] Classified in tariff classification as "Antimony matte, containing not more than 10 per cent of lead."
[c] Classified in tariff classification as "Antimony regulus or metal."
[d] Classified in tariff classification as "Antimony, oxide, salts, and compounds of."

Antimony imported into the United States in 1919–1921.[a]

[General imports.]

Country.	Antimony ore.			Antimony metal.[b]	
	Short tons.	Antimony content.		Pounds.	Value.
		Pounds.	Value.		
1919.					
England				90,048	$8,803
Canada				2,308,880	167,764
Panama	2	1,200	$99		
Mexico	297	219,048	11,332	757,076	60,571
Newfoundland		28	10		
Chile[c]	47	49,624	6,312		
Peru	74	90,726	7,345		
China[d]	455	362,326	23,936	7,847,840	459,613
British India				224,000	10,976
Hongkong[d]	4	4,510	493	68,320	3,949
Japan[d]				2,953,994	159,091
	879	727,462	49,527	14,250,158	870,767
1920.					
England				125,539	14,638
France	467	315,861	10,605		
Canada	132	19,457	2,179	225,272	19,111
Panama	65	80,293	3,856		
Bolivia	388	335,061	22,941		
Chile[c]	162	152,276	11,963		
China[d]	420	450,293	14,185	21,564,851	1,218,802
Hongkong[d]	75	10,200	4,556	706,156	44,909
Japan[d]				2,325,303	177,816
	1,709	1,363,441	70,285	24,947,121	1,475,276
1921.					
England				302,457	14,586
Bolivia	45	46,600	2,450		
Chile[c]	49	54,401	3,334		
China[d]				20,530,079	672,501
Hongkong[d]	119	95,106	5,898		
Japan[d]				320,750	10,027
Germany				45	7
	213	196,107	11,682	21,153,331	697,121

[a] Includes large quantities of antimony metal that went into bonded warehouse and that are not included in the table of imports for consumption.
[b] Includes small quantities of liquated antimony sulphide, known in the trade as "crude antimony," "antimony matte," or "needle antimony."
[c] Imports credited to Chile originated mainly in Bolivia.
[d] Nearly all the imports of antimony ore and metal from Hongkong and Japan are of Chinese origin. Some of the material credited to other countries is possibly also of Chinese origin, having been transshipped in a foreign port.

The general imports decreased about 19 per cent in quantity and 54 per cent in value in 1921 as compared with 1920. Imports of ore decreased 88 per cent. They were received only during the first quarter of the year. The ore came mostly from Hongkong, Chile, and Bolivia. Imports of metal decreased 15 per cent, owing mostly to curtailment of shipments from Japan and China and cessation of shipments from Hongkong and Canada. Receipts were irregularly distributed by months, the minimum being nearly 750,000 pounds in January and the peak being reached in June, with nearly 3,500,000 pounds from China and 330,000 pounds from Japan. The imports from England increased 141 per cent and probably consisted of war stocks. In December the imports amounted to 2,286,638 pounds, about 400,000 pounds more than in December, 1920.

Large quantities of antimonial lead are imported into the United States as type metal.

Type metal imported and entered for consumption, 1917–1921.

Year.	Type metal.		Assumed antimony content.	
	Short tons.	Value.	Short tons.	Percentage.
1917	None.		None.	
1918	276	$35,938	19	6.9
1919	6,697	816,642	1,197	17.9
1920	14,944	1,349,495	2,063	13.8
1921	19,485	1,191,553	4,132	21.2

Foreign antimony exported from the United States, 1917–1921.[a]

Year.	Ore.			Matte, regulus, or metal.	
	Short tons.	Antimony content.		Pounds.	Value.
		Pounds.	Value.		
1917				989,477	$169,260
1918				1,410,970	164,666
1919	3	5,380	$1,665	429,059	33,913
1920				896,034	51,607
1921				299,776	15,741

[a] Exports go mainly to Canada.

STOCKS.

The metallic antimony and matte reported in bond December 31, 1920, by the Bureau of Foreign and Domestic Commerce was 3,743,097 pounds. By the end of February, 1921, it decreased to 2,061,893 pounds. In March it increased to 2,670,198 pounds, but by the end of May it decreased to 1,983,196 pounds, the lowest figure of the year. It then gradually increased by the end of August to 3,809,486 pounds, the highest figure of the year. This was followed by a gradual decrease to 3,064,010 pounds by the end of October, which in turn was followed by an increase to 3,210,340 pounds by the end of the year, as compared with 3,743,097 pounds at the end of 1920.

The average monthly quantity in bond was 2,801,966 pounds during 1921, whereas it was 3,300,300 pounds during 1920.

PRICES.

The average yearly New York quotations for the ordinary grades of metallic antimony for the last 17 years, in cents per pound, are given by the Engineering and Mining Journal as follows:

1905–1914	10.12	1918	12.58
1915	30.28	1919	8.19
1916	25.37	1920	8.49
1917	20.69	1921	4.96

WORLD'S PRODUCTION.[3a]

The following table shows the world's production of antimony for the years 1917–1921, so far as reasonably approximate data are available.

World's production of antimony, 1917–1921, in metric tons.

[Approximate recoverable metal content of ore produced, antimonial lead ores not included.]

Country.	1917	1918	1919	1920	1921
United States	310	45	.....	.....	.....
Canada	87	7	14	.....	.....
Mexico	2,647	3,269	628	1,572	[a]1,502
Bolivia	12,860	4,770	105	(b)	(b)
Peru	450	160	33	6	7
Argentina	812	360	27	(b)	(b)
United Kingdom	2	4	(b)	4	(b)
Hungary	444	(b)	77	314	(b)
France	2,354	1,634	990	[c]1,160	(b)
Italy	960	404	10	187	40
Spain	160	[c]20	.....	(b)	(b)
Serbia	725	(b)	(b)	(b)	(b)
Algeria	4,550	2,218	723	1,000	103
British Africa[d]	300	99	21	73	(b)
China[e]	28,759	15,635	7,767	13,109	14,752
Japan	8	41	1	(b)	(b)
India	182	2	7	(b)	(b)
Indo-China	600	(b)	(b)	(b)	(b)
Asia Minor	400	400	400	400	400
Victoria	1,004	576	580	375	(b)
New South Wales	150	[c]120	2,438	64	(b)
	57,764	.....	.....	.....	.....

[a] First half of year.
[b] No data.
[c] Incomplete data; actual production probably larger.
[d] The production came mostly from Transvaal and Southern Rhodesia.
[e] Production is based on the export figures given in the table on page 127.

CONSUMPTION.

The world's yearly peace-time consumption of antimony from ore produced, not including antimonial lead ores, is about 22,000 metric tons; and that of the United States 10,000 tons. The United States also uses annually about 2,100 tons of virgin antimony contained in domestic antimonial lead and 3,500 tons of secondary antimony recovered from alloys, scrap, and dross, a total of 15,600 tons.

FOREIGN DEPOSITS.

As the United States is almost completely dependent on foreign sources for its supply of antimony, a brief review of production in foreign countries follows.

[3a] For more complete data see pp. 513–564.

NORTH AMERICA.

Canada.[4]—In Canada, as in the United States, high prices continued for a long period would bring out a considerable production, but none is to be expected at peace-time prices. In 1915–1919 the production was the equivalent of 761 metric tons of metallic antimony. Official reports give no production of ore since 1919.

Mexico.—Mexico has produced a considerable quantity of antimony for many years. In 1912–1914 she exported 7,184 short tons of crude ore and regulus to England, and in 1914–1919 she exported 5,380 tons of ore and 3,735 tons of metal to the United States. The production[5] of metallic antimony is reported as follows: 1912–1916, 8,439 metric tons; 1917–1921, 9,618 metric tons.

The principal mines are in the Sierra Catorce, in the States of San Luis Potosi and Queretaro. It is probable that production will be maintained in the future, even during periods of low prices.

SOUTH AMERICA.

Argentina.[6]—In 1911 Argentina produced 30 metric tons and in 1917 2,708 metric tons of antimony ore, which contained about 30 per cent of metal.

Bolivia.[7]—Under the stimulus of high war prices Bolivia from 1915 to 1918 produced large quantities of high-grade antimony ore and 42,566 metric tons of regulus. The ore shipped in 1915–1918 was 62,080 metric tons, of which about 50,000 tons went to England, 10,000 tons to the United States, and 2,000 tons to France.

The chief producing region is in the southern part of the Department of Potosi, particularly the Bustillo, Sur-Chicas, Nor-Chicas, and Porco districts.

Peru.—Extensive antimony deposits occur in many parts of Peru, but only a small quantity of antimony was produced before 1915; from 1915 to 1919 the production was 3,683 metric tons, which contained nearly 60 per cent of metal. More than 90 per cent of the production came from the Department of Puno, in southern Peru.

EUROPE.

The principal antimony-producing countries in Europe are France and Italy, which, from 1913 to 1920, produced, respectively, 15,171 and 7,113 metric tons of regulus. Italy in 1921 produced 40 tons.

ASIA.

China.—For several years China has yielded more than 60 per cent of the world's production of antimony. In 1916 the exports reached their peak and amounted to the equivalent of 42,800 metric tons of metal.

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[4] See Canada Dept. Mines, Mineral production, 1913–1919.
[5] Figures for 1916–1921 from Commerce Reports. Only first half of 1921 included.
[6] Estadística minera de la República: Min. agr., Dir. minas, geol. é hidrol: Bol. 13, Serie A (Minas), pp. 32, 37, 1920.
[7] Comercio especial de Bolivia; exportación, importación, bancos, 1915; 1918, pp. 105–107; 1919, pp. 149–150.

Exports in recent years have been as follows:

Antimony exported from China, 1917–1921, in short tons.[a]

	1917	1918	1919	1920	1921
Regulus	16,338	15,853	6,843	10,721	13,962
Crude	22,202	1,880	2,354	5,023	2,794
Ore	1,254	529	639	1,490	1,297

[a] Given in the Chinese official trade reports in piculs of 133⅓ pounds each.

Antimony is found principally in the Provinces of Hunan, Yunnan, Kweichow, and Kwangsi. About 90 per cent of the production of China comes from the region about Changsha, the center of the smelting industry in Hunan Province. The most productive district is Kai-keng-shan (Shikungshan). The ore, which is mainly stibnite of remarkable purity, occurs as pockets and bunches in a flat bed of dolomitic limestone. The Wah Chang Mining & Smelting Co. largely controls the production. It operates smelters at Changsha, has a selling agency in New York, and has established a large business in the United States.

The Bureau of Foreign and Domestic Commerce has issued a circular for investors telling how to acquire financial interest in antimony properties in China.

Borneo.—British Borneo formerly produced considerable antimony. It exported much ore between 1859 and 1894, and about 1,220 tons in 1914 and 1915.

India.—The total Indian production of antimony ore in 1915–1919 was 1,609 tons. The ore reserves are said to be large but difficult of access.

Indo-China.—There are promising antimony deposits in French Indo-China. The metallic production in 1915 to 1917 was 903 metric tons. The ore exported to France in 1914–1917 was 2,329 tons.

Japan.—Very little antimony ore has been produced in Japan since the development of the Chinese deposits. The smelting of Chinese ores has become an important industry, and the smelter production rose to 10,800 tons in 1916.

Turkey.—The production of antimony in the Turkish Empire comes from the vilayets of Brusa and Smyrna, in eastern Asia Minor. The deposits are large and appear to be rich and capable of greater development. In 1911 the Djinli Kaya mine, near Eudemish, produced 1,500 tons of 50 per cent ore. Exports of antimony ore from Turkey to Great Britain in 1910–1919 were 2,768 metric tons.

AFRICA.

Algeria.[8]—The Algerian deposits are probably capable of considerable development. The ores are nearly all oxidized. They contain about 44 per cent metallic antimony. In 1916–1921, 58,000 metric tons of ore containing approximately 22,000 tons of metal

[8] Econ. Review, vol. 5, No. 20, p. 428, Mar. 24, 1922.

was produced. During the war large deposits were developed at Ain Kerma and supplied antimony to France.

British Africa.—The most promising antimony deposits in British Africa are those of the Murchison Range, in northern Transvaal. In 1913–1919 there was shipped from Transvaal 1,610 metric tons of concentrates and crude. It is reported that 72 tons of regulus was produced in 1920. Deposits occur also in the Steynsdorp district, the Forbes Reef district, Swaziland, and Rhodesia.[9]

AUSTRALIA.[10]

The only important antimony-producing district in Australia is the Costerfield district of Victoria. The concentrates average 48 per cent of antimony and 2½ ounces of gold to the ton. The deposits are very large and are workable to depths of more than 900 feet. The production in 1913–1920 was 17,367 long tons. The current output is about 300 tons a month. It is used with complete success chiefly in making "antox," white oxide of antimony, for paint pigment and regulus. A large plant is being built near the mines by the new owner, the Antox Syndicate (Ltd.), of Sydney.

The antimony metal and ore produced in New South Wales in 1912–1920 was 11,000 long tons. The Hillgrove district was formerly a considerable producer, the highest annual output being 8,687 tons of ore in 1919.

Imports of antimony ore into Great Britain from Australia in 1915 amounted to 3,854 long tons, valued at $471,700.

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[9] Rhodesia Chamber of Mines, Report of executive committee, 1920; South Africa Min. and Eng. Jour. vol. 23, p. 866, Mar. 19, 1921.

[10] Min. Jour. (London), Aug. 7, 1920; Sept. 3, 1921, p. 652; May 20, 1922, p. 381. Eng. and Min. Jour.-Press, vol. 113, p. 1008, 1922.

ARSENIC.

By V. C. Heikes.

PRODUCTION.

All the arsenic produced in the United States in 1921 came from four large western smelting works, where it was recovered from flue dust and precipitated fume. Altogether 6,158 short tons classified as crude and refined arsenic was produced, but only 4,786 tons was sold. The sales of crude arsenic, 70 to 92 per cent pure, amounted to 1,359 tons. The lower grade was used at the point of production to make sodium arsenite for weed killer and smaller lots of higher-grade material were shipped to eastern manufacturers for the same purpose. The prices varied with the grade and ranged from 2.5 to 6.5 cents a pound. The sales of white or refined arsenic, 99 per cent pure, amounted to 3,427 short tons, valued at $580,309, or 8.47 cents a pound. The plate-glass works took about a third of the output in 1921.

No sulphide, realgar, or orpiment mined in the United States in 1921 was placed on the market. Some arsenical material was reduced to elemental arsenic but at a cost too high to compete with the elemental arsenic from Germany. The sales of elemental arsenic were reported at about 25 cents a pound.

The table below includes the production of arsenic from all sources in the United States from the opening of the first plant at Everett, Wash., in 1901 to the end of 1921.

White arsenic, refined and crude, produced in the United States and sold, 1901–1921, by periods.[a]

Period.	Short tons.	Value.	
		Total.	Average per pound (cents).
1901–1905	3,054	$173,266	2.837
1906–1910	6,476	408,356	3.153
1911–1915	18,954	1,038,664	2.740
1916–1919	24,489	4,068,184	8.306
1920	11,502	2,021,356	8.787
1921	4,786	717,700	7.498
	69,261	8,427,526	6.084

[a] Almost all the output was refined white arsenic reported to be above 99.5 per cent of As_2O_3, with the following exceptions: Crude arsenic trioxide containing 97.5 per cent of As_2O_3 reported in 1914, 1915, and 1916 represented 705 tons of the total. In 1920 and 1921 the crude arsenic trioxide produced was 560 tons and 1,359 tons, respectively, and was included in the total for those years. Part of the totals of 1918 and 1919 was elemental arsenic, but the elemental arsenic produced in 1920 and 1921 was not included, as it was reduced from white arsenic purchased on the market.

SOURCES OF PRODUCTION.

The smelting plants that treat lead ores and copper ores in the Western States are the greatest contributors of arsenic-bearing material. This material, consisting of the flue dust and precipitated fume, was refined at the smelting plants at Globe, Colo., Tacoma, Wash., and Midvale and Tooele, Utah, in 1921. Many of the sources of arsenic are described in Mineral Resources for 1920.

The smelters in which arsenic is produced were closed or were in restricted operation in 1921, and very little high-grade arsenic-bearing material was accumulated. Ores carrying considerable arsenic had been sought by the smelters in 1920, but as ores containing a high percentage of arsenic are costly to treat it was deemed more economical to have the smelting charge of lead or copper ore free from an excessive proportion of arsenic during a slackening in the demand for arsenic. On this account an accumulation of any large stocks of either crude or refined arsenic in the hands of American producers has been prevented.

Direct production of arsenic on a large scale has so far been too costly to justify operations and certainly will not be attempted unless some finished product can be made directly from the ore.

A new plant for the treatment of ore and the manufacture of white arsenic as a by-product was completed in 1921 at Toulon, Nev. Some arsenical product said to contain 98 per cent As_2O_3 was produced but not shipped, as the company was awaiting an adjustment in freight rates.

PRICES.

The market price of white arsenic has fluctuated in the last 10 years between 1½ and 20 cents a pound delivered; the low prices were reached in the pre-war period and the high prices at different times within the last few years.

Early in January, 1921, white arsenic was quoted as high as 9½ cents a pound in car lots, but heavy shipments of the product from Japan and Germany combined with decreasing demand and abundance of offerings resulted in a decline of price. In anticipation of a big demand, large supplies of white arsenic were imported, but makers of insecticide, who usually fill orders in February, failed to buy in April, and the price decreased to 7½ cents. From April to the end of 1921 the market was very dull with only occasional sales, principally to the glass trade, and the price ranged from 5¾ to 6½ cents. All the red arsenic was of foreign origin and sold at 15 down to 11 cents a pound. Lead arsenate sold at 14 cents a pound in January, dropped to 9 cents in April, rose to and continued at 9½ cents to November 15, and then rose to 15½ cents and remained at that price until the end of the year. Calcium arsenate ranged in price from 16 to 20 cents a pound throughout the year.

Railroad rates were reduced during 1921 to $14.15 a ton on crude or white arsenic in barrels or casks from Colorado points to New York, and to $13.50 a ton to intermediate points for a minimum of 50,000 pounds. From Utah the rate to New York is $18.40 a ton and to intermediate points as low as $17.20 a ton. From Tacoma or Seattle to the eastern coast no change was reported in the rate, which remained at $25.10 a ton.

IMPORTS AND EXPORTS.[1]

The imports of white arsenic and of arsenic sulphide, red and yellow, in 1921 were less than in 1920, and exports were greater.

Arsenic compounds imported and entered for consumption in the United States, 1913–1921.

Year.	Arsenic or arsenious acid (white arsenic, As_2O_3).		Arsenic and sulphide of, or orpiment.		Sheep dip.		Paris green and London purple.	
	Short tons.	Value.	Short tons.	Value.	Pounds.	Value.	Pounds.	Value.
1913	1,519	$133,597	3,182	$276,849	.....	$40,036	99,692	$14,431
1914	1,594	109,121	2,034	161,592	.....	34,556	15,476	2,235
1915	1,400	113,677	1,783	154,099	.....	19,916	21,056	4,069
1916	1,071	107,876	1,092	124,818	.....	20,134	23,461	5,028
1917	1,178	264,534	2,777	410,341	.....	15,848	48	189
1918	1,847	441,212	4,842	840,600	.....	23,538	.....	.....
1919	4,389	624,494	2,151	316,687	146,803	12,346	18	11
1920	3,740	532,635	4,080	684,016	70,168	5,150	772	277
1921	1,669	253,250	3,343	531,322	61,377	6,362	325	123

Foreign arsenic and sulphide of, or orpiment, reexported, 1914–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1914	700	$79	1918	80,050	$12,017
1915	9,776	526	1919	.....	.....
1916	1,761	1,256	1920	13,799	1,827
1917	113,600	15,840	1921	23,765	2,835

WORLD'S PRODUCTION.[1a]

Great Britain and Germany are large consumers of white arsenic, and should the demand become greater the United States, with normal conditions in its smelting industry, may be able to export large quantities of white arsenic, as well as to supply its own needs.

All available figures representing the total foreign supply of arsenical ore and white arsenic are contained in the following table:

World's production of arsenic ore and white arsenic, 1913–1921, in metric tons (2,204.622 pounds).

Country and kind of ore (where specified).	1913	1914	1915	1916	1917	1918	1919	1920	1921
ORE.									
Australia:									
New South Wales	.....	.....	.....	.....	.....	.....	6	(a)	
Queensland (arsenical pyrites)	.....	.....	.....	.....	33	202	(a)	(a)	
Victoria	(b)	(b)	(b)	(b)	(b)	(b)	(a)	(b)	(a)
Western Australia (ore exported)	.....	.....	.....	11	58	708	.....	1,793	
Canada	(a)	(a)	(a)	(a)	254	978	481	570	(a)
China (arsenic trisulphide, exports)	547	115	58	490	310	138	(b)	(b)	(b)

a White arsenic reported. b No data available.

[1] Figures compiled by J. A. Dorsey, of the United States Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

[1a] For more complete data see pp. 513–564.

World's production of arsenic ore and white arsenic, 1913–1921, in metric tons (2,204.622 pounds)—Continued.

Country and kind of ore (where specified).	1913	1914	1915	1916	1917	1918	1919	1920	1921
ORE—continued.									
France	4,427	250	1,300	1,800	344	728	600	532	586
Germany	5,721	4,732	4,085	3,674	c39,092	c49,800	c26,100	(b)	(b)
Greece	.....	.....	.....	.....	(a)	(b)	(a)	(a)	(a)
Japan	(a)	(a)	(a)	.....	.....	247	968	2,171	(b)
Mexico	.....	.....	.....	.....	(a)	(a)	(a)	(a)	(a)
Portugal	(a)	(a)	146	(b)	(b)	(b)	62	62	(b)
Rhodesia, southern	.....	99	.....	.....	.....	103	220	396	327
Spain (arsenical pyrites)	(a)	(a)	(a)	(a)	(a)	250	150	1,000	(b)
Union of South Africa	.....	.....	.....	.....	(a)	(a)	(a)	(a)	(b)
United Kingdom (arsenical pyrites)	86	(a)	428	305	441	485	76	1,197	(b)
United States	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
WHITE ARSENIC.									
Australia:									
New South Wales	.....	.....	.....	.....	.....	.....	(d)	71	994
Queensland	.....	.....	.....	.....	c10	67	59	310	
Victoria	(b)	(b)	(b)	(b)	(b)	(b)	1,041	(b)	
Western Australia	.....	.....	.....	(d)	(d)	(d)	.....	(d)	
Canada	1,585	1,576	2,174	1,983	2,409	2,252	2,594	1,661	f1,353
China	(a)	(a)	(a)	(a)	(a)	(a)	(b)	(b)	(b)
France	(d)	182	328	874	677	993	735	(d)	(d)
Germany	e 1,892	e 1,637	e 1,456	e 1,280	e 3,551	e 4,401	e 2,098	(b)	(b)
Greece	.....	.....	.....	.....	436	(b)	686	969	640
Japan	21	15	15	.....	.....	213	835	932	(b)
Mexico	.....	.....	.....	.....	1,285	1,881	2,246	2,183	785
Portugal (mostly white)	925	960	859	(b)	(b)	(b)	536	653	(b)
Rhodesia, southern	.....	(d)	.....	.....	.....	(d)	(d)	(d)	(d)
Spain	47	53	83	73	61	104	42	76	(b)
Union of South Africa	.....	.....	.....	.....	3	13	7	10	(b)
United Kingdom	1,722	2,120	2,536	2,586	2,668	2,387	2,568	2,029	(b)
United States	2,280	4,237	4,988	5,430	5,580	5,736	5,469	10,434	4,342

a White arsenic reported. b No data available. c Crude ore mined. d Ore reported. e Estimated arsenic in ore. f Includes small quantity of ore.

Australia: New South Wales, Dept. of Mines Ann. Rept.; Queensland, Under Secretary for Mines, Ann. Rept.; Victoria, Imperial Mineral Resources Bureau; Western Australia, Department of Mines Rept.
Canada, Dept. Mines Ann. Rept.
China, Imperial Mineral Resources Bureau.
France, 1913–1919, Statistique de l'industrie minérale en France et en Algérie; 1920–1921, Annales des mines.
Germany, Vierteljahrsheften zur Statistik des Deutschen Reichs; 1919, Statistische Reichsamt.
Greece, 1917, Tableaux statistiques du mouvement minier; 1919–1920, official questionnaire; 1921, consular report, April 1, 1922.
Japan, Résumé statistique, 1913–1917; Min. Industry, Bureau of Mines, Dept. Agr. and Commerce; 1918, English supplement; 1919, translation from Japanese; 1920, figures by American Consul, Taihoki.
Mexico, Boletin minero, órgano del Departamento de minas.
Portugal, 1913–1918, Imperial Mineral Resources Bureau; 1919 and 1920, official questionnaire.
Rhodesia, southern, 1913–1920, Secretary for Mines Rept.; 1921, Min. Jour. (London), Jan. 28, 1922.
Spain, Estadística minera de España.
Union of South Africa, Dept. Mines and Industries, Ann. Repts.
United Kingdom, Mines and Quarries Rept., part 3.

USES.

Little information is available as to the relative quantities of arsenic consumed in the different industries, as several consumers were unwilling to permit the publication of totals at the present time. However, records show that manufacturers of insecticide in the United States bought the largest quantity of white arsenic in 1921. They make lead arsenate and Paris green for arsenical sprays, calcium arsenate principally for the extermination of the boll weevil, and sodium arsenite for weed killer. Of the lead arsenate made, about two-thirds was sold, but very little of the

calcium arsenate prepared for the cotton growers was marketed, owing to the large stocks in storage. However, reports show an increased quantity of sodium arsenite made as a liquid spray used principally by railroad and highway commissions to kill weeds on rights of way in Eastern and Western States. Some white arsenic was converted into zinc arsenite and sodium arsenate, and some was reduced to the element but was sold at a loss owing to foreign competition. Reports received show that plate glass works in the United States purchased 560 short tons of white arsenic in 1920, against 820 tons in 1921. The red and yellow sulphides of arsenic are used as depilatories for hides; they give the necessary stretch, softness, and clearness of grain to the leather, without the loss of hide substance. Most of the sulphide of arsenic was imported for use in making leather, as a pigment, and in taxidermy. Arsenic is used for hardening shot, but the total quantity in the form of the element so used is comparatively small. In making glass arsenic is used to counteract the coloring effect of metallic oxides and to give brilliancy to the glass.

Some arsenic compounds are used medicinally. One of the uses to which arsenic was put during the war was in the manufacture of poison gas.

Sodium arsenite is used largely in sheep and cattle dips, which play an important part in agriculture. In Australia arsenic compounds are used in the destruction of the prickly pear cactus, which is one of the most troublesome pests. Queensland consumes annually 350 tons of arsenic, chiefly in this way, but this quantity is said to be altogether inadequate to cope with the cactus, and it is estimated that several thousand tons a year would be needed merely to prevent the spread of the pest, and a vastly larger quantity would be required to exterminate it altogether.

Some difficulty has been experienced in getting arsenic free from impurities for the manufacture of arsenic acid. It is reported[2] that antimony, bismuth, and selenium are found in greater or less percentage in all high-grade arsenics, and a great deal of so-called 99 per cent arsenic actually tests less than 99 per cent As_2O_3 because the tests at the source of production are based on the combined arsenic and antimony content. The antimony not only has no value but is objectionable.

FOREIGN DEPOSITS.

The output of arsenic from Canadian sources was smaller in 1921 and that from Mexico was also less. Probably none will be produced in Mexico in 1922. Germany and Japan shipped to the United States an increased quantity of arsenic through different ports, the bulk of it through the port of New York.

UNITED KINGDOM.[3]

Arsenical pyrites and white arsenic are obtained as by-products in the treatment of tin and copper ores in Cornwall and Devon.

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[2] Ambruster, H. W. (New York City). Report on white arsenic. Market circular letter to traders, July 30, 1921.

[3] Mines and Quarries, pt. 3 (annual); Summary of progress for 1918. Geol. Survey Great Britain; annual statement of the trade of the United Kingdom.

The arsenic output is obtained mainly from mines in the Camborne-Redruth and Kit Hill-Calstock districts, where the tin ores contain arsenopyrite.

UNION OF SOUTH AFRICA AND SOUTHERN RHODESIA.[4]

Prior to 1917 no arsenic for commercial purposes had been produced in South Africa, but the remarkable advance in the prices of arsenic compounds during the war and the need for them in South Africa for agricultural uses led to the recovery of arsenic as a by-product at the Stavoren tin mine, in Transvaal. In 1918 two companies engaged in roasting tin ore erected condensing chambers for the purpose of condensing arsenic and in August started to produce about 4 tons of white arsenic a month. The total production in the Union of South Africa for 1918 is given as 15 short tons, compared with 3 short tons in 1917. The sales for 1918 are returned as 18 short tons, valued at £1,759. The output for 1919 was 8 short tons, valued at £663.

Arsenopyrite is of common occurrence in South Africa in association with tin ore, and a considerable quantity of arsenic could, if necessary, be obtained as a by-product in mining and treating such ore. Arsenic compounds occur also as impurities in some gold and other ores of South Africa.

The Union of South Africa consumes annually about £80,000 worth of sodium arsenite for sheep and cattle dips. The value of all the arsenic compounds consumed annually is stated to be about £100,000, and the question of making the Union independent of imports of this commodity has recently received attention. During 1916 there were 6,963 dipping tanks in use in different parts of the Union.

Rhodesia, where 640 dipping tanks were in use in 1917, has a similar problem, and an attempt was made in Southern Rhodesia toward the end of the war to recover white arsenic as a by-product at one of the gold mines. A production of 76 short tons of arsenical ore, valued at £160, is reported for Southern Rhodesia in 1914. The secretary for mines in Southern Rhodesia reports as new production in 1918, 114 short tons of arsenic ore, valued at £7,677, from the Umtali district. The greater part of the ore produced was sent to the British South African Explosives Co., at Modderfontein, but toward the end of the year the output was utilized for the manufacture of cattle dip, which was found to be of good quality and was welcomed locally on account of the difficulty of obtaining cattle dip from overseas.

CANADA.[5]

Arsenopyrite is found abundantly in many parts of Ontario, and some years ago there was a small output of arsenopyritic concentrate from a gold mine operated at Goldboro, in Nova Scotia. During the period 1913–1919, however, the output of arsenic in Canada was obtained almost wholly from the silver-cobalt-nickel-arsenic ores of the Cobalt district, Ontario, being recovered as a by-product in

[4] Union of South Africa Official Yearbook, 1910–1917; Union of South Africa Govt. Mining Engineer Ann. Rept.; Southern Rhodesia Secretary for Mines Ann. Rept.

[5] Mineral production of Canada: Ontario Bur. Mines Ann. Rept.; British Columbia Minister of Mines Ann. Rept.; Trade of Canada.

smelting works at Thorold, Deloro, and Orillia. According to an act to encourage the refining of metals in Ontario, which was passed in 1907 and amended in 1912, a bounty of half a cent a pound is offered by the Ontario Government on white arsenic produced from arsenopyrite ores, but not from ores carrying smaltite or niccolite or cobaltite, the total bounty paid not to exceed $15,000 in any one year. In spite of this bounty there was no production from simple arsenopyrite ores during the period under review, and the producers in the Cobalt district, by the terms of the act, were not entitled to the bounty.

Arsenical gold concentrates have been sent for some years past to Tacoma, Wash., from the Hedley gold mine in the Similkameen district of British Columbia, but it was not until 1917 that an arsenic recovery plant was installed. During the last four months of 1917 and since that date payment has been made for the arsenic in these concentrates.

INDIA.[6]

The quantity of arsenic ore produced in India is small, and the country depends chiefly on foreign sources to satisfy its internal demands. The chief supply is the orpiment mines of Chitral, but the output has fallen off considerably during late years. Orpiment and realgar also occur in scattered fragments on the moraines of the Shankalpa Glacier in Kumaun, where they are collected for sale in the local bazars. Arsenical pyrite is found associated with wolfram and cassiterite in the veins of certain mines in the Mergui district of Lower Burma. Large lumps of leucopyrite, an arsenide of iron, occur in the mica-bearing pegmatites of the Hazaribagh district, and other arsenides have been obtained from pyritic lodes in various localities, but no attempt has yet been made to recover arsenic from them.

The most important source of supply for India is the Chinese Province of Yunnan, whence large quantities are imported into Burma by the Bhamo-Teng-yue route. The mineral orpiment is used mainly as a pigment in the production of the green and gold colors of lacquer work and in the manufacture of other Indian wares. Small quantities of arsenical compounds of Indian origin are exported, mainly to the Straits Settlements.

AUSTRALIA.[7]

During the last part of the war period active prospecting for arsenic minerals took place in various parts of Australia, with productive results in Queensland and Western Australia. Arsenic compounds are used in Australia to destroy the prickly pear, and it was the need of supplies for this purpose that stimulated prospecting.

The Queensland Government in 1917 reserved an area of 150 acres at Jibbinbar, in the Stanthorpe district, for the purpose of prospecting for arsenic. The Beecroft mine, near Sundown, in this district, produced 32 long tons of arsenical pyrites, valued at £580, in 1917.

[6] Annual reports on the mineral production of India: India Geol. Survey Rec.; Annual statement of the sea-borne trade of British India.

[7] Queensland Under Secretary for Mines Ann. Rept.; Western Australia Dept. Mines Ann. Rept.

Prospecting continued actively during 1918, and 199 long tons of arsenical pyrites, valued at £2,981, was produced in that year in the Stanthorpe district, chiefly from the Beecroft mine. At this mine the ore is screened and jigged, and the concentrates, which are estimated to contain 30 per cent of arsenic, are sent to Bendigo, Victoria. A considerable amount of development took place in the State mine at Jibbinbar, and the erection of a concentrating and furnace plant with necessary buildings and other equipment was commenced. The Queensland output for 1919 was 58 long tons of white arsenic.

The Mines Department of Western Australia reports the production in that State of 11 long tons of arsenical ore, valued at £19, in 1916; 57 long tons, valued at £707, in 1917; and 697 long tons, valued at £2,564, in 1918.

Arsenopyrite is reported to be widely distributed in Victoria, and at Ballarat white arsenic is obtained from the flues of roasting furnaces. The white arsenic output of Victoria during 1919 was reported to be 1,025 long tons.

In June, 1918, the maximum price of white arsenic for purchase by wholesalers in Australia was fixed at £60 a ton in containers exceeding 1 hundredweight, and £63 a ton in containers of 1 hundredweight or less. For buyers other than wholesalers the rates were fixed at £66 and £69 6s., respectively, with 20 per cent increase for packages containing less than 56 pounds. These rates apply to metropolitan areas. For other areas the cost of transport is added.

MEXICO.

The Mapimi smelter, in Mexico, operated by the Compañía minera de Peñoles and owned by the American Metal Co. (Ltd.), did not operate any length of time in 1921. The arsenic output was small and consisted mostly of clean-up material around the plant before it was dismantled.

BISMUTH.

By V. C. Heikes.

PRODUCTION.

Bismuth was produced in 1921 by four firms in the United States, but only three of these made reports, and only one was willing to have the totals published. The production of bismuth was less in 1921 than in 1920. The sales did not exceed 232,000 pounds, valued at about $396,000. A considerable stock of bismuth metal held at the bullion refineries is released in quantities and at market prices said to be controlled by an English syndicate.

Most of the bismuth produced in the United States is obtained in the refining of lead bullion, which is derived largely from American ores.

Bolivian tin ores were treated in the United States, and some bismuth was recovered from their residues.

IMPORTS.[1]

Bismuth imported for consumption in the United States, 1916–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1916	76,723	$195,975	1919	57,607	$55,179
1917	69,250	142,300	1920	72,771	161,877
1918	135,700	277,273	1921	94,085	114,891

PRICES.

In January, 1921, the price of bismuth in 500-pound lots was quoted as $2.40 a pound; in February it ranged from $2.35 to $2.40; in March it dropped to $1.50, and it was quoted at that price until the end of the year.

FOREIGN PRODUCTION.

Bolivia.—Bolivia is the chief producer of bismuth. There are numerous deposits of bismuth ore in Bolivia not controlled by Aramayo Franke Mines (Ltd.),[2] but they are generally, though not all, deposits which contain no other metals of value. Many smaller undeveloped deposits of bismuth-bearing ore occur in the Quimsa Cruz and other localities along the eastern Cordillera.

[1] Figures compiled by J. A. Dorsey, of the U. S. Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

[2] Hess, F. L., personal communication, Jan. 18, 1922.

Bismuth ores have been noted by Frank L. Hess in material from Minas Geraes, Brazil, in the form of bismuth carbonate and bismuth vanadate (pucherite). Bismuth is also found in the pegmatites associated with gem beryl and rare-earth minerals containing thorium. There is a possibility of a small production from that region.

China.—The most recent and important discovery of bismuth free from copper and arsenic was made in connection with the wolframite placer deposits of southern China. This tungsten ore, with the bismuth largely in the form of bismutite and but very little bismuth ocher, is produced in the southern part of Kiangsi Province, and has been found in the Wong Yuen, Yuigte, Pao Au, Shiang Shau, and Chin Chow districts, in Kwangtung Province. From these districts the bismuth ore is generally shipped to the larger cities of Changsha, Swatow, and Canton, where it is accumulated and shipped to the port of Hongkong for the market. Reliable statistics are not available as to the production, consumption, or exports of bismuth ore in China. However, exports from Hongkong,[3] as reported to the Geological Survey, amounted to 1,401 bags (112 pounds each) of bismuth ore in 1920 and 1,258 bags in 1921. Fully 60 per cent of the exports go to Liverpool; the remainder to Hamburg, Yokohama, and San Francisco. Other shipments were undoubtedly made from Canton. The ore is usually sold at a flat price, which is determined privately between buyer and seller, according to the grade and quality of the material. During October, 1921, the price at Hongkong for ore containing 45 per cent of bismuth was about 80 Hongkong gold dollars per picul of 133⅓ pounds. The price has been as low as 20 Hongkong gold dollars per picul.

Some of the bismuth ore mined in Kiangsi is sulphide and some is possibly native bismuth. It is said that only about 10 tons a month of 45 per cent ore is allowed on the market by the interests controlling the world bismuth industry.

The American consul at Canton reports the export of bismuth ore and concentrate containing between 50 and 65 per cent of bismuth. Only 266 pounds of the material was exported in 1919, and 32 short tons in 1920. At Swatow exports of bismuth ore were made containing an average of about 60 per cent of bismuth. In 1919 about 59 short tons of material were shipped, and in 1920 approximately 54 short tons.

Rhodesia.—Northern Rhodesia[4] differs markedly from most parts of Southern Rhodesia in its geologic features, and this fact is reflected in its mineral resources. Bismuth is widely distributed, especially on the highlands that overlook the Luano flats. Much the largest deposits are said to be those of the Tanganyika Concessions, on which no development work has been done, but good-sized parcels of ore have been marketed from other claims. Some of the bismuth deposits contain gold; indeed, the present gold output comes almost entirely from claims where the precious metal is associated with bismuth ores.

Saxony.—Bismuth deposits in Saxony[5] occur in the Johanngeorgenstadt district. The production was 113 metric tons of ore

[3] Correspondence of Mitsui & Co. (Ltd.), Hongkong, March 17, 1922.
[4] South African Mining and Eng. Jour., July 2, 1921, p. 1425.
[5] Statistics of production for the Kingdom of Saxony, Germany: Jahrb. Berg-und Hüttenwesen in Sachsen, Jahrgang 1919–20.

in 1918, against 66 metric tons in 1919. The tenor of the ore is not given. In the Schreeberger district 156 tons of bismuth and mixed bismuth-cobalt-nickel ores were produced in 1918, against 122 tons in 1919, and tin-bismuth ore in the Altenberger district amounted to 31 metric tons in 1918, against 9 tons in 1919.

WORLD'S PRODUCTION.[6]

World's production of bismuth, 1913–1920, in kilograms (2.2046 pounds).

Country and ore or metal.	1913	1914	1915	1916	1917	1918	1919	1920
Australia:								
New South Wales, ore and metal	9,144	15,241	18,289	30,481	20,321	31,497	19,305	77,219
Northern Territory, ore	(a)	(a)	(a)	(a)	(a)	57	(a)	127
Queensland, metal	1,626	864	2,540	3,556	4,064	1,118	2,032	965
Bismuth and wolfram concentrates	184,920	196,096	250,962	139,198	133,101	115,829	142,246	49,786
Tasmania, ore and concentrates	5,131	5,690	5,588	3,556	4,267	4,674	1,798	102
Western Australia, ore exported	.....	9,144	1,016	254	508	.....	51	.....
Austria, ore	.....	.....	602,400	325,000	(a)	(a)	(a)	(a)
Bolivia:								
Concentrates	422,484	437,751	474,826	446,540	58,245	75,569	38,289	27,014
Ingots	.....	.....	.....	.....	255,238	248,983	169,451	194,537
Ores	.....	111,917	181,502	168,100	121,060	111,523	93,830	153,005
Residues	.....	.....	6,237	53,786	100,137	53,998	72,506	63,175
British India, metal	.....	.....	.....	.....	254	.....	.....	.....
China	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Germany (Saxony):								
Ore	51,477	57,552	45,934	374,011	49,337	113,171	66,318	(a)
Bismuth-cobalt-nickel ores	165,500	161,250	150,500	117,750	133,250	155,875	121,815	(a)
Tin-bismuth ores	.....	.....	.....	.....	.....	31,000	8,963	(a)
Hungary, ore	(a)	(a)	(a)	(a)	715,800	(a)	(a)	(a)
Japan:								
Ore [b]	315	3,566	10,132	1,129	1,748	934	450	.....
Metal						733	349	224
Madagascar [c]	126	.....	.....	.....	.....	.....	.....	.....
Norway, ore	.....	.....	10,000	.....	10,000	1,000	.....	.....
Peru, metal	25,300	11,187	.....	.....	1,357	.....	.....	7,820
Rhodesia (Northern), ore	.....	.....	.....	372	.....	581	.....	1,216
Spain:								
Ore	56,000	40,000	16,050	10,860	13,900	33,500	75,000	53,300
Metal	.....	.....	.....	.....	.....	12,000	20,000	25,000
Union of South Africa, ore	.....	.....	.....	.....	.....	.....	336	.....
United States	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)

[a] No data available.
[b] The figures for 1913–1917 taken from Résumé statistique are believed to be for ore and metal, as the figure from that publication for 1918 checks with the total of ore and metal reported by the Mineral Industry of Japan.
[c] Not specified whether ore or metal.
[d] Survey not at liberty to publish figures.

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[6] For more complete data see pp. 513–564.

SELENIUM.

By V. C. Heikes.

The output of selenium in 1921 was 59,807 pounds, reported by three producers, who sold 55,978 pounds, valued at $89,148. In 1920 the output of selenium was 92,141 pounds, valued at $175,508. The producing companies reporting in 1921 were the American Smelting & Refining Co., the Raritan Copper Works, and the United States Metals Refining Co. Most of the selenium produced is a by-product in the electrolytic refining of copper.

Selenium produced in the United States and sold, 1917–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1917	39,630	$70,000	1920	92,141	$175,508
1918	103,694	206,540	1921	55,978	89,148
1919	60,025	125,966			

Selenium was used for the decolorization of glass when manganese was scarce. It has its greatest use in giving a red color to glass used for signal lights on railroads and in producing a red coloring for enameled ware. It is also used to overcome the natural green color of ordinary glass. Selenium is peculiar in being a very poor conductor of electricity in the dark but a fairly good conductor in the light, and it is used in several electrical devices whose utility depends on this peculiarity. It has been used either in the form of a black amorphous powder carrying 99 per cent of selenium or as sodium selenite in telephoning along a ray of light and in transmitting sounds and pictures.

Selenium is closely allied to tellurium, and both are widely distributed throughout the world in small quantities. Selenium is found in the siliceous gold ores of the Republic district, Wash., and is recovered in the precipitates of cyanidation mills at Tonopah, Nev., about 5,000 pounds of selenium contained in silver bullion being shipped to the refineries annually from the Tonopah district.

The price of selenium remained the same throughout the year, being quoted at $2 to $2.25 a pound.

Selenium and selenium salts imported for consumption in the United States, 1916–1921.

Year.	Value.	Year.	Value.
1916	$302	1919	$25,866
1917	2,236	1920	.....
1918	.....	1921	2,099

TELLURIUM.

By V. C. Heikes.

A noteworthy development of the year was the discovery that the addition of diethyl telluride to motor gasoline gives increased mileage.

Tellurium is recovered from tank slimes (anode muds) obtained in the electrolytic refining of copper and lead. It has hitherto been considered a waste by-product and an objectionable impurity in the commercial metal. The Raritan Copper Works and the United States Metals Refining Co. reported production of tellurium in 1921. The lead refineries of the U. S. Smelting, Refining & Mining Co. and the American Smelting & Refining Co., at East Chicago, Ind., and Omaha, Nebr., respectively, are in a position to increase their output of tellurium, but not yet in such quantities as to make its use in gasoline practicable.

The present annual production of tellurium in the United States is only a few hundred pounds, and the possible output with present facilities is only 62 tons, whereas 1,500 tons of tellurium would be required annually for use in all motor gasoline. There are some well-known mineral deposits containing tellurium in the United States and other countries, and considerable quantities can be recovered in the refining of copper and lead bullion, although tellurium minerals have not been detected in the copper and lead ores treated; but heretofore there has been almost no incentive to recover the tellurium.

The gold ores mined at Cripple Creek, Colo., the largest single source of tellurium, contained about 14 tons of tellurium in 1919 and 10 tons in 1920, but no effort was made to recover it. Minor occurrences in Colorado are the gold mines of San Juan County; the famous Bassick mine in the Rosita Hills, Custer County; the Red Cloud mine at Red Cliff, Eagle County; and some mines in Gilpin County and at Leadville, but the quantity of tellurium in these ores has not been estimated.

Tellurium is also found in ores in Nevada, particularly near Montello; in California, in Calaveras County; in Montana, at Bannack, Elkhorn, and Georgetown; and in the ores of the Black Hills of South Dakota. Tellurium has also been noted in Arizona at Tombstone and in Yuma County.

Some of the mines of Jalisco and Tepic, in Mexico, contain telluride of silver. Tellurium has been found in the gold ore deposits of Canada and at Kalgoorlie, Western Australia, and in other foreign ore deposits, and still other occurrences may be discovered if an increase in its commercial value justifies the effort.

It is doubtful whether the tellurium mined annually in all ores in the United States exceeds 150 tons. If the future demand justifies, this quantity can doubtless be considerably increased, with a corresponding increase in the production of gold and copper, but the known reserves can hardly be expected to yield 1,500 tons a year.

PLATINUM AND ALLIED METALS.

By James M. Hill.

CRUDE PLATINUM.

Mine returns for the year 1921 indicate a production of crude placer platinum as follows: California, 821 troy ounces; Oregon, 91 ounces; Alaska, 65 ounces—a total of 977 ounces for the United States.

Platinum refiners report purchases of domestic platinum in 1921 as follows: California, 847 ounces; Oregon, 96 ounces; Alaska, 78 ounces—a total of 1,021 ounces. From this quantity of domestic crude platinum purchased 813 ounces of refined metal was recovered, as follows: Platinum, 580 ounces; palladium, 3 ounces; iridium, 99 ounces; osmiridium, 119 ounces; osmium, 12 ounces.

Besides the crude platinum of domestic origin, refiners report purchases of 56,645 ounces of foreign platinum in 1921. Of this quantity 55,286 ounces is reported as of Colombian origin, 1,286 ounces as Russian, and 63 ounces as Canadian. The total imports of platinum from Colombia in 1921, according to figures of the Bureau of Foreign and Domestic Commerce, Department of Commerce, were 31,840 ounces. It hardly seems reasonable to believe that any such quantity as 23,446 ounces of Colombian crude, imported prior to 1921, had been held by agents or banks, in view of the continually falling market. It is more reasonable to interpret the refiners' reports as carrying duplication in sales of crude platinum from one refiner to another; such duplication was not brought out in the answers to the questionnaire.

From the foreign crude platinum reported refined in 1921 was recovered a total of 48,605 ounces of metals of the platinum group, a recovery of approximately 85 per cent.

REFINED PLATINUM METALS.

NEW METALS.

Reports of refiners of crude platinum, gold bullion, nickel, and copper indicate that 56,370 ounces of platinum metals were recovered in 1921, an increase of 14,826 ounces, as compared with recoveries in 1920. As will be seen from the following table, the largest part of this increase was in platinum.

New platinum and allied metals recovered by refiners in the United States in 1917–1921, in troy ounces.

Year.	Platinum.	Palladium.	Iridium.	Osmiridium.	Other.	Total.
1917	33,009	4,779	210	833	.....	38,831
1918	54,399	4,024	465	539	326	59,753
1919	40,220	3,807	401	402	279	45,109
1920	36,015	4,309	418	409	393	41,544
1921	51,791	2,686	286	581	1,026	56,370

Of the total quantity of new platinum metals recovered in 1921, it is estimated that 4,800 ounces can be safely assumed to have been derived from domestic sources.

New platinum metals produced in the United States in 1921, by sources, in troy ounces.

Source.	Platinum.	Palladium.	Iridium.	Osmiridium.	Other.	Total.
Domestic:						
Crude	580	3	99	119	12	813
Ore	1	492	.....	.....	.....	493
Gold and copper refining	2,318	1,165	11	.....	.....	3,494
	2,899	1,660	110	119	12	4,800
Foreign:						
Crude	46,973	302	110	462	758	48,605
Gold and copper refining	1,919	724	66	.....	256	2,965
	48,892	1,026	176	462	1,014	51,570
Total recovery	51,791	2,686	286	581	1,026	56,370

SECONDARY METALS.

Secondary platinum metals are those recovered from the treatment of scrap metal, sweeps, and other waste products of manufacture that contain platinum. Although the figures given in the following table undoubtedly contain some duplication, it is believed that they are of importance, for the secondary metals constitute a considerable item—nearly 26 per cent in 1921—of the total platinum metals available for consumption in the United States:

Secondary platinum and allied metals recovered in the United States in 1917–1921, in troy ounces.

Year.	Platinum.	Palladium.	Iridium.	Total.
1917	59,007	3,347	9,832	72,186
1918	40,378	1,795	3,410	45,583
1919	54,545	3,467	3,504	61,516
1920	51,255	3,100	3,355	57,710
1921	39,131	4,887	1,776	45,794

IMPORTS AND EXPORTS.[1]

The imports of platinum and allied metals for consumption in 1921 were approximately 20 per cent less in quantity than in 1920, but were 15 per cent greater than the imports in 1919.

[1] The data for imports and exports were compiled by J. A. Dorsey, of the U. S. Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Platinum and allied metals imported for consumption in the United States, 1920-21.

Metal.	1920.		1921	
	Troy ounces.	Value.	Troy ounces.	Value.
Platinum or crude platinum and unmanufactured products, ingots, bars, sheets, wire	80,955	$8,474,499	61,941	$4,115,235
Platinum, manufactured products, vases, retorts, etc.	781	[a] 94,408	219	[b] 28,524
Iridium	4,718	726,502	1,345	277,597
Osmiridium	4,473	450,241	2,603	296,277
Osmium	593	39,517	161	13,239
Palladium	6,944	612,248	11,348	629,965
Rhodium	2,053	217,385	609	53,359
Ruthenium	29	2,640	152	4,268
	100,546	10,617,440	78,378	5,418,464

[a] Includes wire to the value of $5,433, imported under 15 per cent duty, quantity not given, and "all other" to the value of $10,278 imported under 50 per cent duty, quantity not given.
[b] Includes 156 ounces of wire, valued at $14,404, imported under 15 per cent duty, and "all other" to the value of $6,947, quantity not given.

Platinum imported into the United States in 1921, by countries.

[General imports.]

Country.	Unmanufactured.		Ingots, bars, plates, etc.		Vases, retorts, etc., for chemical use.		All other.
	Troy ounces.	Value.	Troy ounces.	Value.	Troy ounces.	Value.	
Belgium			1	$123			
Denmark	16	$1,223	17	1,544			
Esthonia	[a] 330	[a] 22,212	[a] 758	[a] 53,691			
France	4,376	302,141	3,101	279,431			$6,365
Germany	170	15,254	7	432	1	$46	306
Italy			5	346			
Netherlands	282	19,413	107	10,800	42	5,447	
Norway	123	8,610	44	2,592			
Sweden	1,580	115,188	128	11,529			
Switzerland							65
England	5,305	373,530	12,030	832,111	20	1,680	14,615
Canada	759	52,892	425	21,187			
Panama	92	5,871					
Cuba	21	1,325					
Argentina	80	5,324	21	1,446			
Brazil	80	4,940					
Chile	3	162	1	70			
Colombia	31,385	1,918,213	455	33,144			
Ecuador	4	295					
Uruguay	5	300					
Venezuela		47	5	300			
China			160	15,000			
Australia	65	4,549					
	44,676	2,851,489	17,265	1,263,746	63	7,173	21,351

[a] Figures for 6 months, July 1 to Dec. 31.

Colombia still supplies most of the crude platinum entering the United States, the reported imports in 1921 being 31,840 ounces, valued at $1,951,357. England sent the United States 17,335 ounces of unmanufactured platinum, valued at $1,205,641, but a large part of this was refined metals. About 1,900 ounces of Australian osmiridium was imported in 1921. Imports of 1,875 ounces of platinum from Norway and Sweden are interpreted as being of Russian origin.

Exports of platinum in 1921 were about 4,000 ounces, of which 3,272 ounces was unmanufactured platinum, valued at $244,473. It is understood that Japan was a rather large buyer of platinum metals in 1921.

CONSUMPTION.

The total consumption of platinum metals in the United States in 1921 as reported by refiners was 176,148 ounces, an increase of about 25 per cent as compared with the consumption in 1920.

It is difficult to reconcile the increase of consumption of platinum metals in the jewelry industry, as indicated in the following table, with the reports from that industry of a marked decrease in business. The electric industry also was in the doldrums during 1921, yet the consumption of platinum metals in that industry, as reported by dealers, showed a little increase as compared with the consumption in 1920. It will be noted that the increase is in the consumption of palladium, and that the consumption of platinum decreased. This apparently means that the palladium alloys have been used to a considerable extent during the year. The increase in their use in dentistry is probable, for with the decrease in price of platinum metals the dentists would use more of these valuable metals instead of substitutes.

Platinum metals consumed in the United States as reported by refiners, 1920–21, by industries, in troy ounces.

Industry.	Platinum.	Iridium.	Palladium.	Total.	Percentage of total.
1920.					
Chemical	13,226	43	240	13,509	9.58
Electrical	23,029	2,673	1,784	27,486	19.49
Dental	6,413	114	8,898	15,425	10.94
Jewelry	77,267	3,108	593	80,968	57.40
Miscellaneous	3,119	116	418	3,653	2.59
	123,054	6,054	11,933	141,041	100.00
1921.					
Chemical	12,273	34	45	12,352	7.01
Electrical	20,574	1,003	7,626	29,203	16.58
Dental	13,181	75	8,501	21,757	12.35
Jewelry	101,258	2,367	1,265	104,890	59.55
Miscellaneous	3,791	3,938	217	7,946	4.51
	151,077	7,417	17,654	176,148	100.00

The relative proportions used in the various industries, as shown in the preceding table, are believed approximately correct, but it is believed that the figures given are much too high and should more nearly be 120,000 ounces, as shown in the table below.

Apparent supply of platinum metals in the United States in 1921, in ounces.

	Platinum.	Iridium.	Palladium.	Total.
Stocks, Jan. 1, 1921	46,747	4,196	16,565	67,508
Production new metal, 1921	51,791	286	2,686	54,763
Production secondary metal, 1921	39,131	1,776	4,887	45,794
Imports	5,432	3,948	11,348	20,728
Total available	143,101	10,206	35,486	188,793
Stocks, Jan. 1, 1922	38,514	4,991	21,042	64,547
	104,587	5,215	14,444	124,246
Exports	4,013			4,013
	100,574	5,215	14,444	120,233

STOCKS.

Stocks of the chief platinum metals in the hands of refiners on December 31, 1921, amounted to 64,547 ounces, a decrease of approximately 4 per cent as compared with the stocks at the beginning of the year. It will be noted, however, that the stocks of palladium and iridium increased.

Stocks of platinum metals on hand in the United States December 31, 1918–1921, in troy ounces.

Metal.	1918	1919	1920	1921
Platinum	51,504	29,228	46,747	38,514
Iridium	3,224	3,359	4,196	4,991
Palladium	10,086	10,235	16,565	21,042
	64,814	42,822	67,508	64,547

MARKET AND PRICES.

CRUDE PLATINUM.

Sellers of domestic crude platinum report having received from $75 to $100 an ounce for their product in 1921; buyers report practically all purchased at a rate of $75 an ounce. Buyers of foreign and domestic crude platinum in the United States who reported purchases in 1921 are listed below:

American Platinum Works, 325 New Jersey Railroad Avenue, Newark, N. J.
Baker & Co. (Inc.), Murray and Austin streets, Newark, N. J.
J. Bishop & Co., Malvern, Pa.
Sigmund Cohn, 44 Gold Street, New York, N. Y.
Thomas J. Dee, Mallers Building, Chicago, Ill.
Goldsmith Bros. Smelting & Refining Co., 20 John Street, New York, N. Y.
Gracier, Klink & Young, 409 Montgomery Street, San Francisco, Calif.
Interstate Smelting & Refining Co., 29 Commercial Street, Newark, N. J.
Kastenhuber & Lehrfeld, 24 John Street, New York, N. Y.
Pacific Platinum Works, 229 East Ninth Street, Los Angeles, Calif.
R. & H. Platinum Works, 709 Sixth Avenue, New York, N. Y.
Shreve & Co., Post and Grant streets, San Francisco, Calif.
Wildberg Bros., 414–419 Pacific Building, San Francisco, Calif.
H. A. Wilson Co., 97 Chestnut Street, Newark, N. J.

REFINED METALS.

The quoted prices[2] for refined platinum have remained within the limits of $65–$85 throughout the year, and it is believed that the average selling price was $75. Iridium began the year at $325 an ounce, but the price was steadily reduced to $160; the average price for the year was approximately $195. Palladium, which at the beginning of the year was quoted at $75 an ounce, gradually declined to $50 in August but rose to $57 by the end of the year; the average selling price for the whole year was approximately $59 an ounce.

The 5 per cent iridium-platinum alloy averaged about $86 an ounce, though it sold as high as $110 and reached a low price of $72. The 10 per cent iridium alloy sold at an average price of $96, with $115 as the highest and $78 as the lowest price for the year.

[2] Eng. and Min. Jour., vols. 111, 112, 1921.

WORLD'S PRODUCTION.[3]

Estimated world's production of crude platinum from placers, 1913–1920, in troy ounces.

Country.	1913	1914	1915	1916	1917	1918	1919	1920
Australia:								
New South Wales [a]	442	244	56	82	259	607	213	796
Tasmania [b]	1,262	1,019	247	222	332	1,607	1,670	2,009
British India [c]	58	37	18	9	4	(d)		
Canada [e]	50	30	100	60	80	40	30	25
Colombia	15,000	17,500	18,000	25,000	32,000	35,000	35,000	35,000
Russia	250,000	241,200	124,000	63,900	50,000	25,000	30,000	35,000
United States	483	570	742	750	605	647	824	613

[a] New South Wales Dept. Mines Ann. Repts.
[b] Tasmania Sec. for Mines Ann. Repts. Tasmania production all osmiridium.
[c] India Geol. Survey Rec.
[d] Production less than 1 ounce (0.31 ounce).
[e] Canada Dept. Mines Ann. Repts. give the following figures (believed low): 1912, none; 1913, 13; 1914, none; 1915, 23; 1916, 15; 1917, 57; 1918, 39; 1919, 25; 1920, 17.

NOTE.—Papua, Annual Report, fiscal year ending June 20, 1920, 100 ounces osmiridium; no data for production in previous years. Russia, 1920, 21 poods (11,060 troy ounces), Econ. Rev., Dec. 23, 1921.

PLATINUM DEPOSITS.

UNITED STATES.

The Salt Chuck palladium-copper mine in Alaska was not operated in 1921, though one shipment of concentrates produced in 1920 was sent to the United States. The output of placer platinum came mainly from Dime Creek, on Seward Peninsula.

California dredges produced practically all the crude platinum reported for 1921, a total of 821 ounces. Of this quantity 486 ounces came from the streams of the mother lode region and 335 ounces from Trinity County. A large part of the Trinity County crude platinum is osmiridium, recovered from Beegum and Hayfork creeks and by the dredges on Trinity River.

A large part of the 91 ounces of crude platinum reported by Oregon miners was produced at the beach mines in Coos and Curry counties, though some crude platinum was saved from the mines near Kerby and Waldo, in Josephine County, and near Sumpter, in Baker County.

The Electrolytic (formerly Rambler) mine, near Holmes, Albany County, Wyo., was under development during the year, and a car of ore was shipped principally for its copper value.

A number of platinum booms were launched in 1921, notably one based on reports of rich platinum ore 11 miles from Winnemucca, Nev., and another on a reported deposit of platinum near Batesville, Ark.

CANADA.

The largest production of platinum metals in Canada comes from the refiners of the Sudbury nickel-copper ores. The International Nickel Co. closed its mines and refinery September 1, 1921. The Mond Co. is the only one now operating.

COLOMBIA.

Two dredges of the South American Gold & Platinum Co. were in operation in Colombia throughout the year, and a third dredge was expected to be in operation early in 1922. The boat of the British Platinum & Gold Corporation is reported to have made satisfactory

[3] For more complete data see pp. 513–564.

recovery,[4] the output from December 21, 1920, to May 21, 1921, being 966 ounces. A dredge has been ordered by the newly organized Colombia Proprietary Gold Mines (Ltd.), a British concern, to operate on Llantin River, 70 miles south of Buenaventura. It is stated on good authority that the native production of platinum decreased considerably during 1921, owing to the lower price paid for the metal by local buyers, which naturally was reduced in conformity with the New York market. It is believed that the production may decline somewhat from that maintained during the war period for a few years, until sufficient dredges are installed to handle adequately the large reserves of gravel.

PAPUA.

The first recorded shipment of osmiridium from Papua was made in 1921 and amounted to 88 ounces. Australians evidently believe that the east end of New Guinea may yet prove a mining field for this valuable iridium-osmium alloy.

RUSSIA.

Very little real news concerning the situation in the Russian platinum fields has been forthcoming. Apparently a little hand mining is going on. Late in 1921 it was reported that a State-controlled platinum trust had been organized by the soviet government, and in May, 1922, it was reported that Louis Duparc [5] is going to Russia to reorganize the platinum-mining industry at the invitation of the soviet government.

It is reported [6] that the production of platinum during the first half of 1921 was about 2,700 ounces.

TASMANIA.

The production of osmiridium in Tasmania in 1921 was 1,750 ounces, as compared with 2,009 ounces in 1920, 1,670 ounces in 1919, and 1,607 ounces in 1918. This is rather surprising in view of the fact that the prices paid for the alloy have been continually lowered until it was reported that many miners had abandoned operations. An excellent description of the various fields in Tasmania in which osmiridium is mined is that by Reid,[7] published in 1921.

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[4] Min. Jour. (London), vol. 25, p. 50, 1921.
[5] Eng. and Min. Jour.-Press, vol. 113, No. 18, p. 786, 1922.
[6] Note by Dept. Commerce of a translation from Economic Life.
[7] Reid, M. A., Osmiridium in Tasmania: Tasmania Geol. Survey Bull 32, 1921.

SECONDARY METALS.

By J. P. Dunlop.

INTRODUCTION.

SCOPE OF REPORT.

"Secondary metals" are those recovered from scrap metal, sweepings, skimmings, and drosses and are so called to distinguish them from metals derived directly from ores, which are termed "primary metals." The distinction does not imply that secondary metals are of inferior quality, for metals derived either from ore or from waste material vary in purity and in adaptability to use in making certain products. The reports to the United States Geological Survey now include secondary copper, zinc, lead, tin, antimony, aluminum, and nickel. The figures obtained by the Survey are supplemental to those on primary metals and are given to enable producers and consumers to form a more comprehensive idea of the quantities of metal available for consumption; in fact, they constitute an essential addition to those given in the seven general reports on primary metals.

RECOVERY OF WASTE MATERIAL.

The collection of waste material is a regular branch of industry involving the gathering, sorting, and shipping of waste valued at many hundred million dollars yearly.

The flow of material from large plants has not been interrupted by the prevailing low prices of waste material, but the collecting of scrap metal and other waste material by itinerant dealers in country districts has been greatly reduced, because the high cost of transportation and sorting absorbed most of the profit. Metallic scrap eventually reaches the market, and the reduction in the cost of labor and in freight rates in 1922 will make the scrap accumulated in country districts available for use. Shipments from country districts were negligible in 1921, and large manufacturing plants, railways, and Government stocks furnished nearly all waste scrap marketed.

There has been an abundant supply of scrap metal in Great Britain, France, and Germany, which has undoubtedly affected the consumption of new metal in those countries. The supplies of waste metal, especially brass, were larger than estimated. These supplies have been greatly depleted by use and by exports. The offerings of scrap metals and surplus stocks of new metals by the War and

Navy Departments of the United States have shown that the quantities of such material on hand at the end of the war were greatly underestimated, and the continued offering of such stocks undoubtedly affected prices of scrap metal in 1921 and reduced the consumption of new metals.

Economies in Government printing make it necessary to omit the general review of the waste-material industry in 1921 and considerable other matter that is usually given in this report. The chapters on secondary metals in Mineral Resources for 1918 and 1919 contain much information regarding the collection of waste material.

CLASSIFICATION OF OLD METALS.

The classification of old metals drawn up by the metal division of the National Association of Waste Material Dealers (Times Building, New York City) and changed from time to time as was found desirable has become the standard with both dealers and manufacturers all over the United States. Its latest classification (circular H) is effective until July 1, 1923, when a new circular will be issued. The metal division, as well as all other divisions of the association, has a grievance committee, whose duty it is to adjust differences between members or to arrange for arbitration if it becomes necessary. This division has in recent years been able to remedy trade abuses, and its constructive work has attracted to it practically all dealers in metal wastes. The present classification follows:

Standard classification for old metals, effective from July 1, 1922, to July 1, 1923.

1. Delivery:

(*a*) Delivery of more or less on the specified quantity up to 2½ per cent is permissible.

(*b*) If the term "about" is used, it is understood that 5 per cent more or less of the quantity may be delivered.

(*c*) Should the seller fail to make deliveries as specified in the contract, the purchaser has the option of canceling all of the uncompleted deliveries or holding the seller for whatever damages the purchaser may sustain through failure to deliver, and if unable to agree on the amount of damages, the arbitration committee of the National Association of Waste Material Dealers (Inc.), appointed for this purpose, to determine the amount of such damages.

(*d*) In the event that buyer should claim the goods delivered on a contract are not up to the proper standard, and the seller claims that they are a proper delivery, the dispute shall be referred to the arbitration committee of the National Association of Waste Material Dealers (Inc.), to be appointed for that purpose.

(*e*) A contract for a carload, unless otherwise agreed upon, shall mean the minimum quantity recognized by the official classification tariff of the district in which the seller is located.

(*f*) A ton shall be understood to be 2,000 pounds, unless otherwise specified.

(*g*) If, through embargo, a delivery can not be made at the time specified, the contract shall remain valid and shall be completed immediately on the lifting of the embargo, and terms of said contract shall not be changed.

(*h*) In case of a difference in weight and the seller is not willing to accept buyer's weights, a sworn weigher shall be employed and the party most in error must pay the costs of handling and weighing.

2. Heavy copper:

This shall consist of copper not less than one-sixteenth inch thick and may include trolley wire, heavy field wire, heavy armature wire, that is not tangled, and also new copper clippings and punchings, untinned and clean, and copper segments that are clean.

3. No. 1 copper wire:

To consist of clean untinned copper wire not smaller than No. 16 B. & S. wire gage, to be free from burnt copper wire which is brittle and all foreign substances.

4. No. 2 copper wire:
   To consist of miscellaneous clean copper wire such as of necessity would be taken out of the heavy copper and the No. 1 copper wire, but to be free of hair and burnt wire which is brittle.
5. Light copper:
   Shall consist of the bottoms of kettles and boilers, bathtub linings, hair wire, burnt copper wire which is brittle, roofing copper and similar copper, free from radiators, brass, lead, and solder connections, readily removable iron, old electrotype shells, and free of excessive paint, tar, and scale.
6. Composition or red brass:
   Shall consist of red scrap brass, valves, machinery bearings, and other parts of machinery, including miscellaneous castings made of copper, tin, zinc, and/or lead, no piece to measure more than 12 inches over any one part, not to weigh over 60 pounds, to be free of aluminum and manganese, also free of railroad boxes, cocks and faucets, gates, pot pieces, ingots, and burned brass.
7. Railroad bearing:
   Shall consist of railroad boxes or car-journal bearings, must be old standard used scrap, free of yellow boxes, plastic and similar bearings, also iron-backed boxes, and must be free of babbitt; also free of excessive grease and dirt.
8. Cocks and faucets:
   To be mixed red and yellow, free of gas cocks and beer faucets; shall be at least half red.
9. Heavy yellow brass:
   Shall consist of heavy brass castings, rolled brass, rod brass ends, brass screws, and tinned or nickel-plated brass tubing; to be free of iron and dirt, and must be in pieces not too large for crucibles; no piece to measure more than 12 inches over any one part. Must also be free of aluminum and manganese mixtures. Condenser tubes shall not be considered as heavy brass.
10. Light brass:
    Shall consist of light sheet brass, forks and spoons, miscellaneous brass that is too light for heavy, to be free of any visible iron, radiators, gun shells containing paper, ashes, or iron, loaded lamp bases, and clock works.
11. New brass clippings:
    Shall consist of the cuttings of new sheet brass, to be absolutely clean and free from any foreign substances.
12. Brass tubing:
    Shall consist of brass tubing, free of nickel plating, tinned, soldered, or tubes with cast brass connections. To be sound, clean tubes, free of sediment, and condenser tubes.
13. No. 1 composition turnings:
    To be free of aluminum, manganese, plastic, and yellow brass turnings, not to contain over 2 per cent iron, to be free of grindings or foreign material, especially babbitt, and free from adulterations made to resemble metal. Turnings not according to this specification subject to sample.
14. No. 1 yellow brass turnings:
    Shall consist of strictly rod turnings, free of aluminum, manganese, composition, and tobin turnings. Not to contain over 3 per cent of iron, oil, or other moisture, to be free of grindings and babbitts. To avoid dispute, to be sold subject to sample.
15. No. 1 pewter:
    Shall consist of tableware and soda-fountain boxes, but in any case must test 84 per cent tin. Siphon tops to be treated for separately.
16. Auto radiators:
    To be classed separately, must be free from iron.
17. Zinc:
    Must consist of clean sheet and cast zinc, also cast batteries, to be free of loose oxide and dross, sal ammoniac cans, and other foreign materials.
18. Tin foil:
    Shall consist of pure foil free of lead compositions and other foreign ingredients and matters.
19. Electrotype shells:
    Must be hand picked and free of loose dross and chunks of dross.
20. Battery lead plates:
    Shall consist of dry-battery lead plates, to be free from wood, rubber, and paper, moisture not to exceed 1 per cent.

21. New sheet aluminum clippings:
Shall consist of new sheet aluminum and cuttings. Must be free from oil, grease, and any other foreign substances. Must be guaranteed not less than 98 per cent pure aluminum.
22. Aluminum wire:
Shall consist of aluminum wire guaranteed 98 to 99 per cent pure aluminum and must be free from corrosion and any other foreign substance.
23. Painted sheet aluminum:
Shall consist of painted sheet aluminum and must be absolutely free from iron, dirt, or any other foreign substance.
24. Aluminum castings:
Shall consist of aluminum castings, free from iron, babbitt, brass, and any other foreign substance. Must not exceed 2 per cent of oil and grease.
25. Old sheet aluminum:
Shall consist of old and manufactured sheet aluminum. Must be free from painted sheet aluminum, iron, dirt, and any other foreign substance.
26. Aluminum borings:
To avoid dispute, should be sold subject to sample.
27. Aluminum foil:
Shall consist of pure aluminum foil, free from paper and any foreign ingredients.
28. Babbitt metal:
Shall contain bearing metal of all kinds. Shall not contain scrap hard metal, Allen metal (which is copper and lead alloy), die cast, zinc boxes, or type metal.
29. Monel metal scrap:
Must be in sheets, clippings, castings, bars, or rods. Must be free of iron and other foreign materials. To avoid disputes, to be sold subject to sample.
30. Monel metal turnings:
Must be free of iron and undue percentage of oil and moisture. To avoid disputes, to be sold subject to sample.
31. Packages:
Shall be good strong packages, suitable for shipment, and each package to be plainly marked with the gross and tare weights so that when packages reach their destination their weights can be easily checked.
When goods are not packed according to the above specifications and shipper wants his rejections returned, the cost of labor shall be charged to the shipper.

REVIEW OF THE SECONDARY-METAL INDUSTRY IN 1921.

Lessened consumption and lower prices were universal in the market for scrap metals in 1921. The quantities of scrap metal utilized as shown by the table on page 158 were very much less than in 1920, and the values decreased at an even greater ratio. There were fewer financial losses in the trade than in 1920, because less scrap was handled on a speculative basis and the material purchased was obtained at prices so low that it could be held for a sure profit when business conditions should improve. The general liquidation that began late in 1920 continued during 1921. Small handlers of scrap material usually bought only when they could make a prompt sale, and the larger smelters and dealers had ample stocks of metals and were not interested in waste material except at very low prices. Moreover, it was difficult to get credit to purchase metals at low prices. Foundries and other consumers of metal had a small demand for their products, consequently they bought lightly and only when sale contracts required to be filled. Hand-to-mouth buying prevailed, and competition for small orders made profits very small. War scrap of all descriptions but particularly cartridge cases and brass scrap, domestic and imported, flooded the market, and the supply of scrap metal and surplus new metal offered by the War Department seemed to be inexhaustible. If domestic consumption had

been normal these supplies from extra sources would have been either consumed or bought by dealers and held for a stronger market, but the uncertainty of the quantity that could be dumped on a weak market and an abnormally low demand for metal products restrained the natural tendency to lay in stocks. As the large consumers, such as brass rolling mills, could use the high-grade scrap and surplus metals sold by the Government, they purchased it direct; they also bought material from foreign sources. There were many other handicaps to contend with, one of which was the high freight rates that greatly retarded the shipment of small lots of waste metals to smelters. A considerable number of secondary smelters lost money; some large and many small plants were shut down; and altogether 1921 was one of the most unprofitable years in the secondary-metal trade.

Dealers in and refiners and smelters of scrap metals and drosses handled less material containing copper, zinc, lead, tin, and antimony in 1921 than in 1920. The quantity of aluminum and nickel scrap alloys and drosses was considerably smaller. The tin recovered as metal was about 1,800 tons less than in 1920, mainly on account of the decrease in the output of tin plate. The tin recovered in alloys and chemical compounds decreased 4,800 tons, for less bronze and brass scrap was used and less tin-plate scrap and old containers were treated. The exports of zinc dross decreased from 2,445 short tons in 1920 to 510 tons in 1921. The recovery of redistilled and remelted zinc decreased about 9,000 tons. The zinc recovered in brass and other alloys was about 28,200 tons less in 1921 than in 1920, owing mainly to the decreased quantity of brass scrap used. Lead recovered as metal decreased nearly 10,000 tons, active demand early in the year preventing a greater decrease. There was an increase of more than 2,000 tons in the quantity of scrap copper re-used in 1921, but the quantity of scrap brass utilized was about 111,300 tons less than in 1920.

During most of the year much more brass scrap was in sight than was necessary to supply the demand, and there was a natural disinclination to purchase brass scrap until the Government holdings of scrap were marketed. A part of the scrap metal sold by the Government was not consumed in 1921. Plants that had made war materials were still heavily supplied with accumulated scrap.

Brass goods were not actively sought by consumers during 1921, and the large stocks of scrap brass caused a serious shrinkage in the domestic demand for copper and zinc. There was only a small decrease in the recoveries of antimony, for considerable quantities of shrapnel bullets, partly imported from Europe, were remelted.

There is a general tendency toward the elimination of the small secondary smelters because of the ability of the larger plants to make alloys and secondary pig metals of guaranteed analysis. This they can accomplish by purchasing large quantities of material and using it to the best advantage under the guidance of expert chemists and metallurgists. A review of some of the difficulties in the production of white and red metals at smelting plants and the effect of impurities in secondary metals is given in a recent article.[1]

[1] Ramson, J. H., Metal Industry, Dec., 1921, pp. 469–472.

PRICES.

The dealers' average buying prices at New York of heavy scrap copper decreased from 11.15 cents a pound in January to 9.65 cents a pound in August, 1921, when the turn of the market was reached, and prices advanced to 11.15 cents in December. No. 1 composition scrap showed a wider and more unstable range of prices, opening at 9.9 cents in January, advancing to 10.9 cents in February, selling for as little as 6.9 cents in August, and closing in December at 8.25 cents, 1.65 cents lower than the quotations on January 1, 1921. Scrap lead opened and closed the year at 4.15 cents a pound, and although it sold at as little as 3 cents a pound late in June the fluctuations were less than in other waste metal. Scrap zinc prices opened at 3.4 cents in January and during the year declined more than those of any other kind of scrap metal. In April they were 41 per cent less than those quoted in January, and the closing prices in December were 29 per cent less. The price of secondary tin followed the trend of prices for primary tin, and black tin pipe was quoted as high as 32.5 cents in January and as low as 21 cents in March. The prices of scrap aluminum and No. 12 alloy were subject to wide fluctuations in 1921, for the quotations for new aluminum ranged from 17.5 to 28.5 cents and the average price was more than 7 cents less in 1921 than in 1920.

Average scrap-metal prices, 1921, in cents per pound.[a]

[New York dealers' weekly average buying prices.]

Date.	Heavy copper.	No. 1 composition.	Scrap lead.	Scrap zinc.	Date.	Heavy copper.	No. 1 composition.	Scrap lead.	Scrap zinc.
Jan. 8	11.15	9.90	4.15	3.40	July 9	10.15	8.40	3.90	2.50
Jan. 15	11.15	11.00	4.50	3.40	July 16	10.15	8.40	3.65	2.65
Jan. 22	11.65	11.40	4.40	3.40	July 23	10.00	8.15	3.60	2.65
Jan. 29	11.15	10.90	4.40	3.15	July 30	9.90	7.90	3.60	2.65
Feb. 5	11.15	10.00	4.15	3.15	Aug. 6	9.90	7.50	3.60	2.25
Feb. 12	11.15	10.90	4.25	3.15	Aug. 13	9.65	7.25	3.60	2.25
Feb. 19	11.40	10.65	4.15	3.50	Aug. 20	9.65	7.25	3.60	2.15
Feb. 26	10.75	10.15	3.75	3.25	Aug. 27	9.65	6.90	3.60	2.15
Mar. 5	10.65	9.65	3.40	2.90	Sept. 3	9.75	7.15	3.65	2.15
Mar. 12	10.75	9.65	3.70	3.00	Sept. 10	9.75	7.40	3.90	2.30
Mar. 19	10.15	9.25	3.70	2.65	Sept. 17	10.05	7.40	4.15	2.30
Mar. 26	10.25	9.25	3.65	2.65	Sept. 24	10.40	7.40	4.20	2.15
Apr. 2	10.50	10.00	3.75	3.25	Oct. 1	10.65	7.55	4.20	2.40
Apr. 9	10.25	9.75	3.90	2.00	Oct. 8	10.65	7.55	4.20	2.65
Apr. 16	10.25	9.75	3.90	2.00	Oct. 15	10.90	7.75	4.20	2.80
Apr. 23	10.50	10.00	3.75	3.00	Oct. 22	10.65	7.50	4.20	2.90
Apr. 30	10.15	9.75	4.05	3.15	Oct. 29	10.65	7.75	4.05	2.90
May 7	10.40	9.75	4.40	3.15	Nov. 5	10.50	7.90	3.95	2.75
May 14	10.65	10.00	4.50	3.15	Nov. 12	10.50	7.90	3.95	2.50
May 21	10.75	10.00	4.40	2.90	Nov. 19	11.00	7.90	3.93	2.50
May 28	11.00	10.00	4.15	2.90	Nov. 26	11.25	8.15	3.95	2.40
June 4	11.00	9.50	4.15	3.00	Dec. 3	11.65	8.25	3.90	2.30
June 11	11.15	9.25	3.90	2.90	Dec. 10	11.55	8.25	4.00	2.40
June 18	10.90	9.00	3.65	2.75	Dec. 17	11.55	8.25	4.15	2.40
June 25	10.40	8.75	3.00	2.65	Dec. 24	11.55	8.25	4.15	2.40
July 2	10.40	8.75	3.65	2.40	Dec. 31	11.15	8.25	4.15	2.40

[a] Waste Trade Journal, New York, Jan. 21, 1922.

SECONDARY METALS RECOVERED.

The quantity of the metals contained in numerous alloys made partly or wholly from secondary material can not be definitely ascertained. The figures given as the result of the annual inquiry made

by the Geological Survey are only approximate, but they constitute the sole available data on an important industry.

The decrease in the value of the secondary metals, exclusive of gold, silver, platinum, iron, steel, and ferroalloys, recovered in the United States was due mainly to the much lower average price of copper, tin, lead, and zinc and to the smaller quantities of scrap metals.

The value of the secondary platinum, iridium, and palladium recovered in 1921 amounted to about $3,569,500, which was about 66 per cent of the value of the platinum and allied metals imported for consumption in the United States in 1921.

The value of the gold or silver contained in old jewelry, dental waste, silver spoons, tableware, ornaments, and other articles remelted or refined in 1921 was $32,833,084. Mints and refineries reported the recovery of 6,932,908 fine ounces of silver and $25,900,176 in gold from waste or discarded material. Jewelry and dental waste are the largest sources of secondary gold, and silverware and photographic wastes of secondary silver. The recoveries of silver from waste film and from photographic solutions probably amounted to more than 1,000,000 ounces.

The low price of secondary silver after June, 1920, and the small recovery made from waste films made the handling unprofitable except where there was little or no expense for collecting and shipping. Most of the silver recovered from photographic waste was obtained from solutions. It is difficult to estimate the value of ferrous scrap remelted in 1921. Estimates of the quantity vary from 5,000,000 to 6,000,000 long tons. A considerable part of the scrap ferrous metal contained nickel, tungsten, manganese, chromium, vanadium, molybdenum, or other alloys, which made it many times more valuable than the ordinary commercial iron and steel scrap, though the market is limited, and some knowledge regarding consumers is necessary to locate prospective purchasers. The railways are, on the whole, the largest producers of most kinds of metal scrap, as well as the largest users of new and remelted metal. It is estimated that the railways usually supply more than 40 per cent of the scrap iron and steel.

It is impracticable and unnecessary to segregate the statistics relating to the melting, refining, and use of secondary metals according to States. Nearly all the secondary aluminum was reported from Ohio, Michigan, Connecticut, Illinois, Wisconsin, and Missouri. The largest recoveries from tin dross, tin scruff, and clean tin scrap were made in Pennsylvania, New York, New Jersey, Illinois, and Indiana. Nearly all the secondary nickel was reported from Connecticut, New York, and New Jersey. The recoveries of lead, zinc, and copper and of such alloys as babbitt, bronze, brass, and pewter were more generally distributed, though the largest secondary smelters and refineries are in Pennsylvania, Illinois, Michigan, Ohio, and New York. There has been some increase in the last few years in the number and capacity of smelters treating secondary metals in San Francisco, Seattle, and Tacoma.

Secondary metals of certain classes recovered in the United States in 1920 and 1921.

	1920		1921	
	Short tons.	Value.	Short tons.	Value.
Copper, including that in alloys other than brass	130,600	$48,060,800	113,350	$29,244,200
Brass scrap remelted	259,800	77,454,500	148,500	32,000,000
Lead as metal	56,350	19,944,000	46,370	9,340,200
Lead in alloys	68,300		57,410	
Zinc as metal	42,850	8,181,000	33,833	3,967,300
Zinc in alloys other than brass and in chemical compounds	7,650		5,840	
Tin as metal	7,200	22,705,700	5,400	9,668,500
Tin in alloys	16,300		11,500	
Antimony as metal	200	938,560	29	464,400
Antimony in alloys	5,400		4,691	
Aluminum as metal	5,000	9,489,100	3,650	3,775,400
Aluminum in alloys	10,500		5,250	
Nickel as metal	270	1,733,600	86	680,400
Nickel in nonferrous alloys	1,930		859	
	.....	188,507,260	.....	89,140,500

SECONDARY COPPER.

Secondary copper recovered in 1921.

	Short tons.
Copper as metal	99,020
Copper in alloys other than brass	14,330
	113,350
Copper from new scrap	28,400
Copper from old scrap	84,950
	113,350
Brass scrap melted:	
New clean scrap	81,300
Old scrap	67,200
	148,500
Copper content of brass scrap (averaging about 70 per cent copper):	
New scrap	56,910
Old scrap	47,040
	103,950
Total secondary copper:	
From new scrap	85,310
From old scrap	131,990
	217,300
rass scrap imported	20,449
Scrap copper imported	2,853
Brass scrap exported	2,969
Scrap copper exported	308

In 1921 of the total quantity of secondary copper recovered 53,243 tons (12,249 tons more than in 1920) was recovered by plants refining primary metals and the remainder by plants treating only secondary materials. The copper produced by smelters of secondary material included 45,777 tons of pig copper, 14,330 tons of copper in alloys other than brass, and 103,950 tons of copper in remelted brass. These figures indicate a decrease for 1921 of 11,229 tons of pig copper, of 19,270 tons in alloys other than brass, and of 77,910 tons in brass.

The value of the copper, both as metal and in alloys, is computed at 12.9 cents a pound, the average price for the year of all marketable grades of new metal.

According to the Bureau of Foreign and Domestic Commerce the exports of scrap copper and brass in 1921 showed an increase and the imports were slightly less than in 1920. Many railways sell or turn in the larger portion of their brass and copper scrap and other metal waste to dealers in part payment for new material, but the reports received show that the railways utilized in their own shops and foundries more than 14,000 tons of brass in addition to 900 tons of copper and 3,300 tons of copper in alloys other than brass. The railway reports, however, frequently include alloys termed "brass" which should more properly be designated "bronze." Some other alloys of copper are known by names that do not even suggest the metals alloyed.

The names recommended by the American Society for Testing Materials to be used in connection with certain brass, bronze, and nickel alloys of copper are given in the report on secondary metals in Mineral Resources for 1919.

In the past large producers of certain virgin metals, particularly copper, zinc, and antimony, have paid too little attention to scrap metals; they have not realized that such metals as secondary copper and brass exert sufficient influence to affect the marketing and prices of new metals. The effect of the surplus quantity of scrap metals in 1921 has, however, been significantly shown in the much lower consumption of virgin copper and zinc, while manufacturers of brass rods, sheets, and other products purchased large quantities of turnings and cartridge casings. The bulk of the domestic brass scrap has passed into consumers' hands or into the dealers' storage, so that during the last part of 1922 war scrap will cease to have any serious effect on the domestic scrap-metal market. In an article entitled "Present and future of the copper industry," by Cornelius F. Kelley, president of the Anaconda Copper Co., published in Metal Industry April 22, 1922, an estimate is given of about 205,000 tons of copper contained in brass scrap available in Europe and the United States on January 1, 1921. Nearly all of this scrap was located in Great Britain and France.

SECONDARY LEAD.

Secondary lead recovered in 1921.

	Short tons.
Secondary lead recovered by smelters that treat mainly ores	14,799
Secondary lead recovered by plants that treat only scrap and drosses	31,571
	46,370
Secondary lead recovered in remelted alloys:	
Lead content of antimonial lead scrap treated at regular lead smelters	2,032
Lead content of drosses and scrap alloys treated at secondary smelters	55,378
Total lead in alloys	57,410
Total secondary lead recovered	103,780
Refined primary lead produced in the United States:	
From domestic ores	398,222
From foreign ore and base bullion	50,367
Lead content of antimonial lead ores treated at regular smelters from foreign and domestic sources	8,475

The secondary lead recovered in 1921 amounted to about 17 per cent less than in 1920. The secondary lead recovered as pig lead decreased 9,980 tons, and the secondary pig lead recovered by those smelters whose product is mainly primary metal increased 2,012 tons. The quantity of secondary lead recovered in alloys decreased 10,890 tons. A portion of the lead recovered from alloys was derived from old babbitt, solder, type metal, and white-metal drosses. The main sources of secondary pig lead are old pipe, lead cable, battery plates, and lead lining of acid tanks. Regular primary smelters reported the recovery of 2,032 tons of lead in scrap antimonial lead, or 655 tons less than in 1920. About 20,000 tons of antimonial lead in shrapnel was imported under the classification of type metal in 1921.

The use of lead in batteries has expanded rapidly with the growth of the automotive industry, and a large part of the secondary lead now recovered is obtained from old batteries.

The total output of secondary lead was equal to about 23.1 per cent of the refined primary lead produced in the United States in 1921, compared with 23.5 per cent in 1920. It was exceeded by the output of primary domestic lead in only one State—Missouri.

SECONDARY ZINC.

Secondary zinc recovered in 1921.

	Short tons.
Zinc recovered by redistillation	17,573
Zinc recovered by remelting, sweating, etc	16,260
Total zinc recovered unalloyed	33,833
Zinc recovered in alloys other than brass	5,840
Zinc recovered in brass (estimated)	38,627
Zinc dust made from zinc dross	839
Zinc dross used for zinc dust (estimated)	980
Lithopone made from zinc skimmings and ashes	19,306
Zinc dross and skimmings exported	510

The output of secondary zinc (including that in brass) in 1921 was 39 per cent of the output of primary zinc in the United States, against 25 per cent in 1920. The recovery was 37,200 tons less than in 1920, mainly owing to the much smaller quantity of zinc contained in brass and other alloys recovered, though the recovery from scrap zinc, dross, and skimmings decreased 9,017 tons.

Only one smelter—in New Jersey—treated zinc drosses and skimmings by means of large graphite retorts of 600 to 800 pounds capacity instead of the small clay retorts used by smelters treating ore or mixed ore and drosses. The many uses of zinc drosses and skimmings create active competition for their purchase. Considerable zinc is recovered by sweating, and the residues are then sold for redistillation.

The production of zinc from drosses and skimmings made by smelters by redistillation was 3,798 tons less in 1921 than in 1920.

The zinc recovered in alloys other than brass amounted to 5,840 tons, compared with 7,650 tons in 1920. Of the secondary zinc recovered unalloyed, more than half was obtained by redistillation from drosses and skimmings and the remainder by sweating and remelting. In addition to the 33,833 tons of remelted and redistilled zinc, 19,306 tons out of a total production of 51,828 tons of the zinc pigment lithopone (containing approximately 22 per cent zinc sulphide and oxide) was made from zinc skimmings and ashes. It is estimated that the zinc content of skimmings and ashes used for lithopone was 3,730 tons. The quantity of zinc chloride made in 1921 was 62,523 short tons, of which 44,535 tons, containing 9,798 tons of zinc, was made from zinc ashes and skimmings. The secondary zinc recovered in all zinc pigments in 1921, including that in lithopone, was 4,024 short tons, and that recovered in zinc sulphate 427 short tons. The exports of zinc drosses, which amounted to 5,123 tons in 1919 and to 2,445 tons in 1920, decreased to 510 tons in 1921. The zinc recovered in brass decreased from about 65,000 tons in 1920 to 38,627 tons in 1921.

Two plants in San Francisco are making zinc dust from zinc dross, so that all that material has a good market; but none of the secondary plants on the Pacific coast treat zinc ashes or skimmings, and it is necessary to ship them to eastern plants for treatment.

SECONDARY ANTIMONY.

Secondary and primary antimony recovered in 1921.

	Short tons.
Antimony recovered (mainly in alloys)	4,720
Antimony imported as metal, in ore, or as oxide or salts	10,735
Antimony produced from domestic antimony ores	None.
Antimony (metallic) produced by smelters	None.
Antimony content of antimonial lead ores from domestic and foreign sources treated at regular lead-ore smelters	1,589

The production of secondary antimony, of which all but 29 tons was recovered in alloys, decreased nearly 16 per cent in 1921. The value assigned is arbitrary and is based on the average yearly price for ordinary brands of antimony as published by the American Metal Market. The regular smelters reported the recovery of 309 tons of antimony contained in 2,340 tons of antimonial lead scrap. The recovery from secondary sources was equal to 44 per cent of

the imports. The principal materials refined or resmelted that contained antimony as an alloy were hard-lead drosses, babbitt, battery plates, solder, pewter, and type metal. Antimony used in the rubber, glass, enamel, paint, and ceramic industries does not yield any secondary recoveries. The quantity of antimony used for coloring rubber and for pigments has materially increased in the last four years.

No production of antimony from domestic antimony ore was reported in 1921. There was 10,064 short tons of primary antimonial lead which contained 1,589 tons of antimony recovered at smelters.

SECONDARY TIN.

Secondary tin recovered in 1921, with imports and domestic production.

Tin recovered as pig tin.....short tons..	5,400
Tin recovered in alloys and chemical compounds.....do....	11,500
	16,900
Clean tin-plate scrap treated, including 1,858 long tons imported.....long tons..	104,070
Old tin-coated containers treated.....do....	209
Metallic tin recovered at detinning plants.....pounds..	1,135,230
Tin content of tin tetrachloride, tin bichloride, and tin oxide made by detinning plants.....pounds..	2,607,770
Total tin recovered at detinning plants.....do....	3,743,000
Tin tetrachloride, tin bichloride, and tin oxide made at detinning plants.....pounds..	5,846,800
Average quantity of tin recovered per long ton of old tin-coated containers.....pounds..	28.0
Average quantity of tin recovered per long ton of clean tin-plate scrap.....pounds..	35.93
Tin imported as metal in 1921.....short tons..	27,101
Tin concentrates imported.....do....	15,316
Tin produced from foreign concentrates smelted in United States.....short tons..	11,542
Tin content of domestic ores concentrated but not smelted .....short tons..	4
Percentage of secondary tin recovered to tin imported as metal, in ore, or as oxide.....	39.8

Although the United States consumes more than 50 per cent of the world's output of tin, apparently only 4 tons of metallic tin was derived from domestic mines in 1921.

The secondary tin recovered decreased from 23,500 tons, valued at $22,705,700, in 1920 to 16,900 tons, valued at $9,668,500 in 1921, equal to about 40 per cent of the tin imported as pig metal or in concentrates into the United States during the year (42,417 short tons). The value of the recovered tin here assigned is arbitrary and is based on the yearly average price (28.605 cents) for 99 per cent metal, with prompt delivery at New York, given by the American Metal Market. The secondary tin in alloys decreased 4,800 tons, and the secondary pig tin decreased 1,800 tons.

Nearly all clean tin-plate scrap is detinned by one of three processes—the electrolytic alkali, the chlorine, or the alkali saltpeter.[2]

The tin reported recovered in alloys and compounds included the tin content of products made in several plants from clean tin-plate

[2] A short history of the detinning industry: Met. and Chem. Eng., August, 1917, pp. 187–189.

scrap and old tin-coated cans. The materials recovered included some tin oxide and putty powder, but consisted mainly of tin tetrachloride and tin bichloride. The production of these compounds is stated together, in order to avoid disclosing confidential information. As the products are made from scrap tin and thus conserve the primary metal, they are properly regarded as recovered tin.

The largest recoveries of tin were made from the scruff and drosses that occur in making tin plate and terneplate and amounted to about 5,000 tons. The quantity of tin plate and terneplate made in 1921 was 793,198 long tons, or 643,500 long tons less than in 1920.

About 1,871 short tons of tin was recovered from clean scrap tin plate, either as pig tin or as tin chloride or tin oxide. Apparently only about 300 tons of pig tin was recovered from scrap tin (not tin plate), clippings, old tin pipe, tin foil, and collapsible tubes, and it is impossible to give separately the quantities of tin recovered from these sources. Old block-tin pipe is most acceptable scrap, but the quantity available is steadily declining. There was also a considerable quantity of tin recovered from waste tin liquors used in dyeing.

Nearly all the tin-plate scrap imported in 1921 came from Canada.

Tin-coated scrap and old cans are frequently utilized in western mining regions for their iron content in the precipitation of copper from mine waters; the tin coating, however, is wasted. A small portion of the clean tin strips cut from sheets is sold to makers of boxes and baskets and is used to bind, strengthen, or fasten the tops of the containers made. The Metal & Thermit Co. completed in 1921 a plant at San Francisco for treatment of scrap tin plate, which formerly was shipped to eastern plants.

A large quantity of tin was recovered in bronze, and part of the brass remelted contains a little tin and lead, which in the aggregate amounts to a considerable quantity. Other alloys from which secondary tin was recovered were solder, babbitt, pewter, terne metal, and electrotype metal.

From reports received by the Geological Survey the clean tin-plate scrap detinned in 1921 was about 50,700 long tons less than in 1920. Metal and tin chloride containing altogether 5,800 pounds of tin was recovered from the old tin-coated cans. The average metallic content of the tin oxide was given as 78.9 per cent, that of the tin bichloride as 24.5 per cent, and that of the tin tetrachloride between 45.4 and 46 per cent.

The relatively small quantity of secondary tin recovered from tin-plate scrap and old tin-coated cans is significantly shown when compared with the quantity of tin used in making tin plate. It is estimated that 15,900 short tons of tin was used by makers of tin plate in 1921, that the total recovery of tin as metal and in compounds from tin-plate scrap and old cans was 1,871 short tons, and that of this quantity only 3 tons was obtained from old cans.

All the old cans detinned in 1921 were treated by the dry chlorine process at plants in New Jersey and at East Chicago, Ind., owned by the Metal & Thermit Co., and by the electrolytic process at plants at Sewaren, N. J., and Streator, Ill., owned by the Vulcan Detinning Co. The cans purchased were classified as follows:

Class 1. Unused empty and unrusted tin cans not exceeding the 1-gallon size, with or without labels attached but otherwise free from foreign material such as ice, water, ashes, paint, varnish, white lead, and similar insoluble (in water) contents.

Class 2. Used cans not exceeding the 1-gallon size and otherwise as described in class 1.

Class 3. Used empty and unrusted tin cans exceeding in size the 1-gallon size, but not exceeding the 5-gallon size and otherwise as described in class 1.

During 1921 the quoted prices for old tin cans were $3 to $3.43 a long ton (2,240 pounds) delivered at Sewaren, N. J., Chrome, N. J., and East Chicago, Ind. A description of the method used in treating old tin-coated cans is given in this report for 1919.

New tin-plate clippings were treated at the above-named plants that treated old cans and also by the Johnson & Jennings Co., of Cleveland, Ohio, the Republic plant of the Vulcan Detinning Co., at Pittsburgh, Pa., and the San Francisco plant of the Metal & Thermit Co.

The plants utilizing old tin cans which can handle 25,000 tons a year treated only 209 long tons in 1921. These plants have never received shipments large enough to operate steadily at full capacity, even when the prices of tin and black sheet-steel scrap were 50 per cent higher than those prevailing in 1921. The detinning companies have reduced the price paid for old cans to about $3 to $3.40 a long ton, or one-third of that paid in 1919 and 1920, for tin declined to less than 25 cents a pound in 1921, and bundled black-plate scrap brought less than $6 a long ton. The present prices do not warrant even local collection of old cans, and the plants will probably be closed. The supply of tin chloride, which is made almost entirely from scrap and which is the main product of detinning plants, is ample since war uses have ceased.

The collection of tin foil and old collapsible tubes largely by persons and organizations for charitable purposes has also ceased, because much of the foil and many other containers are either not now made from tin or contain only a small quantity of tin.

Although there is now a supply of tin sufficient for all requirements at less than pre-war prices, there are two good reasons for restricting its use to the lowest point. One is that the supply of new tin is derived almost entirely from foreign sources, and the other is that tin is a relatively high-priced metal and the use of substitutes giving approximately equal efficiency radically reduces the cost of many alloys, such as solder, babbitt, and other bearing metals.

SECONDARY ALUMINUM.

Secondary aluminum recovered in 1921, with imports, exports, and domestic production of primary aluminum.

Secondary aluminum recovered	short tons	3,650
Aluminum recovered in alloys (mainly No. 12)	do	5,250
		8,900
Value of primary aluminum produced in the United States in 1921		$10,906,000
Aluminum (crude and semicrude) imported for consumption	pounds	32,559,017
Aluminum exported as pig aluminum, plates, sheets, and alloys	pounds	2,196,378

The recovery of secondary aluminum as pig aluminum or in alloys in 1921 amounted to 8,900 short tons, valued at $3,775,400, compared with 15,500 tons, valued at $9,489,100, in 1920.

Some of the larger secondary smelters and refiners of aluminum in 1921 were as follows:

Peninsular Smelting Co., Detroit, Mich.
Michigan Smelting & Refining Co., Detroit, Mich.
United Smelting & Aluminum Co., New Haven, Conn.
United States Reduction Co., East Chicago, Ind.
Great Western Smelting & Refining Co., St. Louis, Mo.
Cleveland Electro Metals Co., Cleveland, Ohio.
Loewenthal Co., Chicago, Ill.
National Smelting Corporation, Cleveland, Ohio.
Bremer Aluminum Corporation, St. Louis, Mo.
L. Cohn & Co., Chicago, Ill.
Columbia Smelting & Refining Co., New York, N. Y.
W. F. Jobbins Co. (Inc.), Aurora, Ill.

Various products are made by smelters and refiners from scrap aluminum.

A large quantity of No. 12 secondary ingots (92 per cent aluminum and about 8 per cent copper) is made by smelters from old or defective castings, borings, and scrap, as is shown by the fact that the secondary recovery of aluminum in alloys was nearly 60 per cent of the total recovery in 1921. The depressed condition of the automotive industry, which is estimated to consume 22 per cent of the aluminum production, is reflected in the decreased consumption of secondary No. 12 alloy. The recovery of aluminum in alloys in 1921 was only half of that reported in 1920. Two recent articles relating to aluminum are "Iron pot melting practice for aluminum alloys," by Robert J. Anderson (Metal Industry, Feb., 1922, p. 60), and "German practice in melting aluminum scrap" (Min. Jour., London, Aug. 6, 1921, p. 591).

The following articles on aluminum were published in the report for 1919 on secondary metals:

Casting losses in aluminum foundry practice in the United States, by Robert J. Anderson.
Scrap aluminum, by Charles Vickers.
Tentative specifications for aluminum presented to the American Society for Testing Materials.

SECONDARY NICKEL.

Secondary nickel recovered in 1921, with imports, exports, and domestic production of primary nickel.

	Short tons.
Nickel recovered as metal	86
Nickel recovered in nonferrous alloys and salts	859
	945
Nickel produced as a by-product from the electrolytic refining of copper at domestic refineries	111
Nickel imported for consumption in the United States as nickel or in nickel ores and matte, oxide, and alloys	2,198
Nickel, nickel oxide, and matte exported	213

The nickel recovered from secondary sources in 1921 includes nickel in monel metal but not that in ferrous alloys. Most of the nickel in matte, oxide, ore, etc., imported came from the Sudbury district, Ontario. The nickel-copper matte imported is partly refined and partly smelted to make monel metal.[3] No nickel was re-

[3] Bregman, Adolf, Methods of melting and casting, uses, etc., of monel metal: Metal Industry, vol. 19, pt. 1, pp. 9–10; pt. 2, pp. 64–65.

covered at the refinery of the Missouri Cobalt Co., at Fredericktown, Mo., from ores that contain nickel, lead, copper, and cobalt, and the only production from domestic sources was obtained from the electrolytic refining of copper.

In ordinary years about 60 per cent of the refined nickel produced is used in nickel steel, 30 per cent in white-metal alloys, 5 per cent in anodes for plating, and 5 per cent for miscellaneous purposes, including the manufacture of salts and other chemical compounds.

As nickel is used chiefly as an alloy in steel and as the secondary recoveries of nickel reported to the Geological Survey in 1921 were obtained solely from nonferrous scrap, it is evident that the 945 tons of nickel reported forms only a portion of the nickel in alloys recovered and reused, though that portion was much larger in 1921 than usual. It is probable that very little nickel steel was made in 1921, for large accumulations of scrap nickel steel derived from scrapped war material were available. The nickel imported for consumption in 1921 was only about one-eleventh of the imports in 1920. The secondary metal recovered from nonferrous sources in 1921 was equal to about 43 per cent of the imports, whereas in 1920 it amounted to only 9 per cent of the imports.

The secondary nickel reported in 1921 was nearly all recovered from old nickel anodes, nichrome, nickel silver, and monel metal. A nickel alloy which is now being more generally used is composed of about 60 per cent nickel and the remainder mainly chromium. The properties and uses of this alloy, called "nichrome," are described in an article recently published.[4] Extracts from this article are given in the report on secondary metals in 1919.

Analyses of various nickel alloys have already been published by the United States Geological Survey.[5]

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[4] Equipment for foundry and plating room: Brass World, vol. 16, pp. 146–147, May, 1920.
[5] Hess, F. L., Nickel: U. S. Geol. Survey Mineral Resources, 1915, pt. 1, pp. 763–765, 1917

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA.

(MINES REPORT.)

By Charles G. Yale.[1]

INTRODUCTION.

Certain of the metal-mining industries in California increased their output in 1921, but others remained depressed. The increase was entirely in gold and silver, as copper, lead, and zinc all showed greatly decreased output, as compared with 1920. The total value of the metals produced in California increased about 10 per cent. Only one of the larger copper-mining companies continued operations throughout the year, and most of the smaller mines remained idle. The large lead-producing companies curtailed operations or shut down entirely, and the shipments made by any of the mines were comparatively small. Only one producer of zinc reported an output, and that was produced in experimenting with the process of recovery adopted. Deep-mine gold increased 4 per cent, but placer gold increased about 15 per cent. Silver from deep mines increased 114 per cent; the increase from placers was only nominal. Costs of mining still continued higher than the normal rate, and in consequence not only have operations been curtailed among the larger mines but many mines, large and small, have been entirely idle. Under such conditions new enterprises have been few, and older companies have not spent much money either in equipment or in prospecting. Development has continued where circumstances warranted it, but smaller crews than usual have been employed. For many years the gold output from deep mines exceeded that from placers, but in 1921 the placers led by more than half a million dollars, as a result of the activities of the gold dredges.

In the five Mother Lode counties of the State, in one of which the deepest gold mines are in operation, the output of siliceous milling ore increased to some extent in 1921, but the average recovery per ton of ore was less by 97 cents.

The average value of all metals from ores of the State in 1921 was $10.50 a ton, as compared with $10.20 in 1920. From ordinary ore sent to gold and silver mills the recovery was $7.67 a ton in gold and $0.09 in silver, compared with $8.34 in gold and $0.16 in silver in 1920. The recovery from concentrates treated was $29.15 a ton in gold and $5.89 in silver, compared with $24.22 in gold and $6.34 in silver. Crude ore of all kinds sent to smelters averaged $5.02 in gold and $75.61 in silver. Old tailings treated (38,299 tons) averaged $2.84 in gold and $0.56 in silver.

The details of mining work in the Mother Lode counties of California are given in the section on production by counties. The fig-

[1] In the preparation of the statistics in this chapter the writer has had the assistance of J. M. Hill and Helen M. Gaylord, both of the United States Geological Survey.

ures given by counties are not strictly confined to the mines in the Mother Lode itself, as generally recognized, but include those on the so-called East belt and others. By far the larger part of the output, however, comes from mines in the Mother Lode. A condensed statement is given in the following table:

Gold and silver produced at gold mills in Mother Lode counties in California in 1921.

County.	Ore treated (short tons).		Gold and silver recovered in bullion.		
	Total.	At gold milling plants.	Gold.	Silver (fine ounces).	Average per ton of ore.
Amador	309,899	279,049	$1,465,656	14,876	$5.31
Calaveras	204,866	204,866	952,743	6,635	4.68
Eldorado	4,354	3,354	26,544	228	7.98
Mariposa	30,577	30,577	290,834	3,412	9.62
Tuolumne	24,769	22,695	84,678	1,720	3.81
	574,465	540,541	2,820,455	26,871	5.27

County.	Concentrates produced.				Value of total recovery.	
	Short tons.	Gold.	Silver (fine ounces).	Average value in gold and silver per ton of concentrates.	Total.	Average per ton of ore.
Amador	5,535	$473,388	5,405	$86.50	$1,959,325	$7.02
Calaveras	6,333	356,590	2,939	56.77	1,318,907	6.44
Eldorado					26,772	7.98
Mariposa	699	33,124	1,759	49.90	329,129	10.76
Tuolumne					86,398	3.81
	12,567	863,102	10,103	69.48	3,720,531	6.88

In this table the concentrates include only concentrates made at gold and silver mills and not those made at concentrating mills. The value of total recovery includes gold and silver recovered as bullion and from concentrates from gold and silver mills, but not that recovered from ores sent direct to smelters, from concentrates made at concentrating mills, or from old tailings.

Amador, Calaveras, Eldorado, and Mariposa counties produced more in 1921 than in 1920, and Tuolumne County less. The 540,541 tons treated at milling plants yielded $3,720,531 in gold and silver, or an average per ton of $6.88 in 1921, as compared with 440,516 tons treated in 1920, yielding $3,460,423, or an average of $7.85.

The total quantity of ore treated at gold and silver mills from the deep mines of the State was 816,159 tons, which was 94,979 tons more than in 1920.

Crude ore sold or treated in California in 1921, in short tons.

County.	Siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Total.
Amador	309,899				309,899
Butte	81				81
Calaveras	204,866				204,866
Eldorado	4,354				4,354
Fresno	30				30
Imperial, Los Angeles, Orange, and San Diego [a]	772		1,000		1,772

Crude ore sold or treated in California in 1921, in short tons—Continued.

County.	Siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Total.
Inyo	9,718		2,626		12,344
Kern	11,559				11,559
Lassen	1,603				1,603
Madera	69				69
Mariposa	30,577				30,577
Mono	2,607	61	53		2,721
Nevada	199,678				199,678
Placer	7,712				7,712
Plumas	15,686	306,037			321,723
San Bernardino	45,582	36	221		45,839
Shasta	3,153		47	2,953	6,153
Sierra	28,768				28,768
Siskiyou	854				854
Trinity	228				228
Tuolumne	24,769				24,769
Yuba	1				1
	902,566	306,134	3,947	2,953	1,215,600
Increase or decrease, 1921	+114,430	−40,067	−25,829	+2,044	+50,578
Average value per ton in gold and silver	$12.00	$0.67	$25.07	$1.35	$9.16

[a] Counties combined to avoid disclosure of individual output.

Value of ore mined and treated in California in 1921.

Class.	Ore (short tons).	Total value.		Average value per ton.	
		In gold and silver.	In all metals.	In gold and silver.	In all metals.
Siliceous	[a] 902,566	$10,832,046	$10,833,349	$12.00	$12.00
Copper	306,134	205,617	1,701,958	.67	5.60
Lead	3,947	98,948	154,007	25.07	39.02
Zinc	2,953	3,980	69,655	1.35	23.59
	1,215,600	11,140,591	12,758,969	9.16	10.50

[a] Includes 29,846 tons of silver ore from 20 silver mines, yielding $184,989 in gold and $3,228,340 in silver.

Gold and silver produced in California in 1921, by methods of treatment.

County.	Ore to gold and silver mills.			Ore to concentrating mills (short tons).	Concentrates produced.		
	Short tons.	Gold.	Silver (fine ounces).		Short tons.	Gold.	Silver (fine ounces).
Amador	279,049	$1,465,656	14,876		5,535	$473,388	5,405
Butte	81	4,610	82				
Calaveras	204,866	952,743	6,635		6,333	356,590	2,939
Eldorado	3,354	26,544	228				
Fresno	30	331	5				
Imperial, Los Angeles, Orange, and San Diego [a]	500	3,454	24	1,000	44	165	7,423
Inyo	495	4,654	82	9,914	444	59,225	4,387
Kern	11,548	81,363	1,682		27	1,454	145
Lassen	1,603	39,943	1,234				
Madera	69	433	11				
Mariposa	30,577	290,834	3,412		699	33,124	1,759
Mono	2,072	19,121	1,252		8	1,363	580
Nevada	199,677	2,524,313	33,605		73	5,271	103
Placer	7,712	46,915	505		19	1,013	82
Plumas	15,686	59,100	636	306,024	19,850	30,863	169,789
San Bernardino	4,765	26,479	2,300	480	17	124	2,226
Shasta	1,729	20,392	207				
Sierra	28,768	590,983	5,128		1	310	3
Siskiyou	654	5,781	61				
Trinity	228	9,488	75				
Tuolumne	22,695	84,678	1,720	75	12	827	13
Yuba	1	227	3				
	816,159	6,258,042	73,763	317,493	33,062	963,717	194,854
Average value per ton		$7.67	$0.09			$29.15	$5.89

[a] Counties combined to avoid disclosure of individual output.

Gold and silver produced in California in 1921, by methods of treatment—Continued.

County.	Crude ore to smelter.			Old tailings treated.		
	Short tons.	Gold.	Silver (fine ounces).	Short tons.	Gold.	Silver (fine ounces).
Amador				30,850	$91,587	14,411
Eldorado				1,000	2,005	18
Imperial, Los Angeles, Orange, and San Diego [a]				272		914
Inyo	1,875	$16,225	81,509	60	269	42
Kern	11	620	53			
Mono	149	12,381	13,273	500	4,889	55
Nevada	1	186	5			
Plumas	13	21	488			
San Bernardino	38,593	188,608	3,200,837	2,001	1,964	5,339
Shasta	3,006	1,157	4,247	1,418	3,366	61
Siskiyou				200	620	3
Tuolumne	1	124	3	1,998	4,217	718
	43,649	219,322	3,300,415	38,299	108,917	21,561
Average value per ton		$5.02	$75.61		$2.84	$0.56

[a] Counties combined to avoid disclosure of individual output.

In 1921 California gold and silver mills and concentrating plants treated 1,133,652 tons of ore, yielding altogether $7,221,759 in gold and $268,617 in silver, a total value of $7,490,376, or an average of $6.61 a ton. The average value in 1920 was $6.63.

The bullion recovered in mills in 1921 amounted to $6,258,042 in gold and $73,763 in silver, an average of $7.76 in both metals. From 816,159 tons of milling ore and 317,493 tons of concentrating ore, 33,062 tons of concentrates were obtained, containing $963,717 in gold and $194,854 in silver, an average value of $35.04 a ton of concentrates.

Of the smelting ores 43,649 tons were treated and yielded $219,322 in gold and $3,300,415 in silver. The total yield of gold and silver was $80.63 a ton, which was a much higher average value than in 1920, owing to the high-grade silver ore shipped from the mines in San Bernardino County.

Tailings and slag amounting to 38,299 tons were treated and yielded an average of $2.84 in gold and $0.56 in silver to the ton.

PRODUCTION.

STATISTICAL SUMMARY.

Gold, silver, copper, lead, and zinc produced in California, 1915–1921.

Year.	Number mines producing.	Ore.	Gold.[a]	Silver.[b]	Copper.	Lead.	Zinc.	Total value.
		Short tons.		*Fine oz.*	*Pounds.*	*Pounds.*	*Pounds.*	
1915	608	3,002,779	$22,442,296	1,678,756	40,751,625	4,579,245	13,094,032	$32,263,844
1916	589	3,187,642	21,410,741	2,564,354	55,897,118	12,407,493	15,256,485	39,749,263
1917	490	3,003,250	20,087,504	1,775,431	48,153,139	21,868,628	10,872,716	37,685,985
1918	703	2,503,411	16,528,953	1,427,711	47,674,660	13,372,049	5,561,393	31,187,807
1919	650	1,714,911	16,695,955	1,107,189	21,732,507	3,568,267	472,990	22,201,898
1920	500	1,165,022	14,311,043	1,706,327	12,626,272	4,813,510	1,165,509	18,973,660
1921	573	1,215,600	15,704,822	3,629,223	11,743,404	1,124,276	1,057,731	20,952,423
Increase or decrease, 1921	+73	+50,578	+1,393,779	+1,922,896	−882,868	−3,689,234	−107,778	+1,978,763

[a] Includes placer gold. [b] Includes placer silver.

The 294 deep mines producing in 1921 may be classified by chief metallic product, as follows: Gold, 252; silver, 18; copper, 4; lead, 19; zinc, 1. Of the deep mines there were 14 more gold mines, 6 less copper, and 15 less lead than in 1920. Of the 279 placer mines producing, 60 were hydraulic, 35 dredges, 59 drift, and 125 surface or sluicing mines. There were 9 more hydraulic mines, 5 less dredges, 14 more drift mines, and 62 more surface or sluicing mines than in 1920. The dredges are enumerated by the number of boats at work, some companies operating one and others several. The number of metal mines of all kinds reporting production was 573.

Mine production of gold, silver, copper, lead, and zinc in California in 1921.

County.	Ore treated (short tons).	Deep-mine gold.		Placer gold.		Total gold.	
		Fine ounces.	Value.	Fine ounces.	Value.	Fine ounces.	Value.
Amador	309,899	98,231.77	$2,030,631	6,618.28	$136,812	104,850.05	$2,167,443
Butte	81	223.01	4,610	21,872.75	452,150	22,095.76	456,760
Calaveras	204,866	63,338.98	1,309,333	9,018.31	186,425	72,357.29	1,495,758
Del Norte, Lassen, and Mendocino [a]	1,603	1,932.24	39,943	90.99	1,881	2,023.23	41,824
Eldorado	4,354	1,381.06	28,549	268.97	5,560	1,650.03	34,109
Fresno	30	16.01	331	616.98	12,754	632.99	13,085
Humboldt				99.36	2,054	99.36	2,054
Imperial, Los Angeles, Orange, and San Diego [a]	1,772	175.08	3,619	25.98	537	201.06	4,156
Inyo	12,344	3,888.04	80,373			3,888.04	80,373
Kern	11,559	4,036.26	83,437	61.00	1,261	4,097.26	84,698
Madera	69	20.95	433	29.99	620	50.94	1,053
Mariposa	30,577	15,671.47	323,958	354.93	7,337	16,026.40	331,295
Merced and Stanislaus [a]				1,045.00	21,602	1,045.00	21,602
Mono	2,721	1,826.35	37,754			1,826.35	37,754
Nevada	199,678	122,377.62	2,529,770	1,953.96	40,392	124,331.58	2,570,162
Placer	7,712	2,318.52	47,928	4,089.62	84,540	6,408.14	132,468
Plumas	321,723	4,352.98	89,984	1,797.81	37,164	6,150.79	127,148
Sacramento				81,785.77	1,690,662	81,785.77	1,690,662
San Bernardino	45,839	10,505.84	217,175	19.01	393	10,524.85	217,568
Shasta	6,153	1,205.26	24,915	11,743.81	242,766	12,949.07	267,681
Sierra	28,768	28,603.80	591,293	1,014.62	20,974	29,618.42	612,267
Siskiyou	854	309.65	6,401	1,752.82	36,234	2,062.47	42,635
Trinity	228	458.98	9,488	20,728.93	428,505	21,187.91	437,993
Tuolumne	24,769	4,346.30	89,846	298.96	6,180	4,645.26	96,026
Yuba	1	10.98	227	229,201.76	4,738,021	229,212.74	4,738,248
Total, 1920	1,215,600	365,231.15	7,549,998	394,489.61	8,154,824	759,720.76	15,704,822
	1,165,022	350,739.55	7,250,430	341,557.15	7,060,613	692,296.70	14,311,043
Increase, 1921	50,578	14,491.60	299,568	52,932.46	1,094,211	67,424.06	1,393,779

[a] Counties combined to avoid disclosure of individual output.

Mine production of gold, silver, copper, lead, and zinc in California in 1921—Continued.

County.	Deep-mine silver.		Placer silver.		Total silver.	
	Fine ounces.	Value.	Fine ounces.	Value.	Fine ounces.	Value.
Amador	34,692	$34,692	768	$768	35,460	$35,460
Butte	82	82	1,677	1,677	1,759	1,759
Calaveras	9,574	9,574	658	658	10,232	10,232
Del Norte, Lassen, and Mendocino [a]	1,234	1,234	15	15	1,249	1,249
Eldorado	246	246	55	55	301	301
Fresno	5	5	70	70	75	75
Humboldt			37	37	37	37
Imperial, Los Angeles, Orange, and San Diego [a]	8,361	8,361	6	6	8,367	8,367
Inyo	86,020	86,020			86,020	86,020
Kern	1,880	1,880	17	17	1,897	1,897
Madera	11	11	16	16	27	27
Mariposa	5,171	5,171	80	80	5,251	5,251
Merced and Stanislaus [a]			223	223	223	223
Mono	15,160	15,160			15,160	15,160
Nevada	33,713	33,713	193	193	33,906	33,906
Placer	587	587	481	481	1,068	1,068
Plumas	170,913	170,913	177	177	171,090	171,090
Sacramento			5,254	5,254	5,254	5,254
San Bernardino	3,210,702	3,210,702	4	4	3,210,706	3,210,706
Shasta	4,515	4,515	1,066	1,066	5,581	5,581
Sierra	5,131	5,131	105	105	5,236	5,236
Siskiyou	64	64	230	230	294	294
Trinity	75	75	1,315	1,315	1,390	1,390
Tuolumne	2,454	2,454	51	51	2,505	2,505
Yuba	3	3	26,132	26,132	26,135	26,135
Total, 1920	3,590,593	3,590,593	38,630	38,630	3,629,223	3,629,223
	1,676,427	1,827,305	29,900	32,591	1,706,327	1,859,896
Increase, 1921	1,914,166	1,763,288	8,730	6,039	1,922,896	1,769,327

County.	Copper.		Lead.		Zinc.		Total value.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
Amador							$2,202,903
Butte							458,519
Calaveras							1,505,990
Del Norte, Lassen, and Mendocino [a]							43,073
Eldorado							34,410
Fresno							13,160
Humboldt							2,091
Imperial, Los Angeles, Orange, and San Diego [a]			13,240	$596			13,119
Inyo	42,233	$5,448	1,046,609	47,097			218,938
Kern							86,595
Madera							1,080
Mariposa							336,546
Merced and Stanislaus [a]							21,825
Mono	2,195	283	26,233	1,180			54,377
Nevada							2,604,068
Placer							133,536
Plumas	11,583,441	1,494,264					1,792,502
Sacramento							1,695,916
San Bernardino	15,702	2,026	23,694	1,066			3,431,366
Shasta	99,833	12,878	14,500	653	1,057,731	$52,887	339,680
Sierra							617,503
Siskiyou							42,929
Trinity							439,383
Tuolumne							98,531
Yuba							4,764,383
Total, 1920	11,743,404	1,514,899	1,124,276	50,592	1,057,731	52,887	20,952,423
	12,626,272	2,323,234	4,813,510	385,081	1,165,509	94,406	18,973,660
Increase or decrease.	−882,868	−808,335	−3,689,234	−334,489	−107,778	−41,519	+1,978,763

[a] Counties combined to avoid disclosure of individual output.

GOLD.

Of the deep-mine gold produced during the year 99 per cent was derived from siliceous ore. Of the placer gold the dredges yielded $856,421 more than in 1920, the hydraulic mines $96,575 more, the drift mines $64,486 more, and the surface or sluicing mines $76,729 more. From 1896, when gold dredging began in California, to the end of 1921, the output of gold from that source has been $124,999,984. Since 1898 the Oroville or Feather River dredging field, in Butte County, has produced $31,698,775 in gold, and $2,556,216 has been derived in the last 12 years from adjacent fields in the same county; from 1903 to 1921, inclusive, the Marysville or Yuba River field, in Yuba County, produced $44,234,042; and since 1902 the Folsom or American River field, in Sacramento County, has produced $28,501,049. Dredges have also been and are being operated in several smaller fields in other northern counties of the State.

The placer mines produced 52 per cent of the total gold yield in 1921 and the deep mines 48 per cent, as compared with 49 per cent and 51 per cent in 1920. This is the first time since the restrictions were placed on hydraulic mining in California that the output of gold from gravel mines has exceeded that from the quartz mines. The dredges produced 49 per cent of the total gold from all sources in 1921. Of the total placer gold, dredges produced 95 per cent, hydraulic mines 2 per cent, drift mines about 2 per cent, and sluicing mines 1 per cent. The larger dredging fields are at Oroville, Butte County; Folsom, Sacramento County; and Hammonton, Yuba County. In these three fields 20 dredges were working in 1921. There were also 1 in an "outside" field of Butte County, 1 in Amador, 3 in Calaveras, 1 in Placer, 4 in Shasta, 2 in Stanislaus, and 3 in Trinity. The Yuba County field made by far the largest increase in output of gold in 1921, as compared with 1920—$1,266,112—and reached the highest peak of total production ever attained in a dredging field in the State. Sacramento County also increased its dredge-gold yield by $112,902, but Butte County shows a reduction of $21,633.

Certain difficulties are encountered in assigning the gold reported as produced in California to its exact county of origin, and some counties are likely to be credited with a larger output of gold than they really made. The reason is that in certain mining centers, such as Grass Valley and Nevada City, in Nevada County; Jackson, in Amador County; Redding, in Shasta County; Oroville, in Butte County; and Yreka, in Siskiyou County, gold is brought for sale to banks or other buyers or for express shipments from a large area within range of these towns. This gold comes mostly from small mines leased and individually worked by foreigners who will not answer inquiries, and very much of it is from "high graders," who prefer, when possible, to sell or ship their gold at points at some distance from the places where it was mined. Hundreds of small lots are received by storekeepers in exchange for goods and by banks and gold-dust buyers, who make no effort to ascertain the name of the seller or the locality from which he comes. But these lots in the aggregate make large sums in a year and must be credited, for example, to "small mines at Grass Valley," though much of the gold may have come from Placer, Yuba, Sierra, Plumas, Butte, or other neighboring counties.

Mine production of gold in California in 1921, by sources, in fine ounces.

County.	Placers.	Deep mines.					Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Total.	
Amador	6,618.28	98,231.77				98,231.77	104,850.05
Butte	21,872.75	223.01				223.01	22,095.76
Calaveras	9,018.31	63,338.98				63,338.98	72,357.29
Del Norte, Lassen, and Mendocino [a]	90.99	1,932.24				1,932.24	2,023.23
Eldorado	268.97	1,381.06				1,381.06	1,650.03
Fresno	616.98	16.01				16.01	632.99
Humboldt	99.36						99.36
Imperial, Los Angeles, Orange, and San Diego [a]	25.98	167.10		7.98		175.08	201.06
Inyo		[b] 3,104.08		783.96		3,888.04	3,888.04
Kern	61.00	4,036.26				4,036.26	4,097.26
Madera	29.99	20.95				20.95	50.94
Mariposa	354.93	15,671.47				15,671.47	16,026.40
Merced and Stanislaus [a]	1,045.00						1,045.00
Mono		1,813.39	7.98	4.98		1,826.35	1,826.35
Nevada	1,953.96	122,377.62				122,377.62	124,331.58
Placer	4,089.62	2,318.52				2,318.52	6,408.14
Plumas	1,797.81	2,922.97	1,430.01			4,352.98	6,150.79
Sacramento	81,785.77						81,785.77
San Bernardino	19.01	[c] 10,497.81	1.02	7.01		10,505.84	10,524.85
Shasta	11,743.81	1,151.27		3.00	50.99	1,205.26	12,949.07
Sierra	1,014.62	28,603.80				28,603.80	29,618.42
Siskiyou	1,752.82	309.65				309.65	2,062.47
Trinity	20,728.93	458.98				458.98	21,187.91
Tuolumne	298.96	4,346.30				4,346.30	4,645.26
Yuba	229,201.76	10.98				10.98	229,212.74
	394,489.61	362,934.22	1,439.01	806.93	50.99	365,231.15	759,720.76
Total, 1920	341,557.15	[d] 346,284.17	1,860.45	2,594.93		350,739.55	692,296.70

[a] Counties combined to avoid disclosure of individual output.
[b] Includes 27.96 ounces gold from siliceous silver ore mined at 5 properties.
[c] Includes 8,912.90 ounces gold from siliceous silver ore mined at 12 properties.
[d] Includes 3,561.66 ounces from silver ores.

Value and source of placer gold mined in California in 1921.

County.	Hydraulic.	Dredging.	Drift.	Surface placers.	Total.
Amador	$17,525	$115,318		$3,969	$136,812
Butte		420,017	$3,328	28,805	452,150
Calaveras		164,079	17,798	4,548	186,425
Del Norte and Mendocino [a]				1,881	1,881
Eldorado			1,819	3,741	5,560
Fresno				12,754	12,754
Humboldt	1,517			537	2,054
Imperial				537	537
Kern				1,261	1,261
Madera				620	620
Mariposa				7,337	7,337
Merced and Stanislaus [a]		17,364		4,238	21,602
Nevada	16,413		22,801	1,178	40,392
Placer		45,685	24,884	13,971	84,540
Plumas	2,646		32,269	2,249	37,164
Sacramento		1,687,646	2,769	247	1,690,662
San Bernardino				393	393
Shasta		233,527		9,239	242,766
Sierra	14,520		3,103	3,351	20,974
Siskiyou	33,755			2,479	36,234
Trinity	76,432	350,587		1,486	428,505
Tuolumne			6,180		6,180
Yuba		4,722,564	12,460	2,997	4,738,021
	162,808	7,756,787	127,411	107,818	8,154,824

[a] Counties combined to avoid disclosure of individual output.

The gold recovered from ore and tailings in California in 1921 by amalgamation was 283,404.29 fine ounces; by cyanidation, 38,190.18 fine ounces, a large part of which was derived from the concentrates; from concentrates and ore sent to smelters, 43,726.68 fine ounces. These figures are only approximate, as many small operators keep no separate accounts, and even the larger companies do not always segregate by methods of treatment the figures for the gold they obtain. This is especially the condition where larger mills amalgamate in the batteries and on the plates and pass the tailings and concentrates direct to the cyanide plants. All the placer gold was recovered by amalgamation.

SILVER.

By far the largest output of silver in California in 1921 was made by San Bernardino County, followed in order by Plumas and Inyo counties. The silver output of the State was the greatest in years and came mainly from the mines and leased properties of the California Rand Silver (Inc.), in San Bernardino County. The silver recovered from the ore and tailings treated in 1921 by amalgamation was 67,827 fine ounces; by cyanidation, 12,729 fine ounces; and by ores directly smelted or from concentrates from the flotation process, 3,510,037 fine ounces.

Mine production of silver in California in 1921, by sources, in fine ounces.

County.	Placers.	Deep mines.					Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Total.	
Amador	768	34,692				34,692	35,460
Butte	1,677	82				82	1,759
Calaveras	658	9,574				9,574	10,232
Del Norte, Lassen, and Mendocino [a]	15	1,234				1,234	1,249
Eldorado	55	246				246	301
Fresno	70	5				5	75
Humboldt	37						37
Imperial, Los Angeles, Orange, and San Diego [a]	6	938		7,423		8,361	8,367
Inyo		[b] 23,084		62,936		86,020	86,020
Kern	17	1,880				1,880	1,897
Madera	16	11				11	27
Mariposa	80	5,171				5,171	5,251
Merced and Stanislaus [a]	223						223
Mono		[c] 3,857	5,624	5,679		15,160	15,160
Nevada	193	33,713				33,713	33,906
Placer	481	587				587	1,068
Plumas	177	729	170,184			170,913	171,090
Sacramento	5,254						5,254
San Bernardino	4	[d] 3,205,110	62	5,530		3,210,702	3,210,706
Shasta	1,066	890		699	2,926	4,515	5,581
Sierra	105	5,131				5,131	5,236
Siskiyou	230	64				64	294
Trinity	1,315	75				75	1,390
Tuolumne	51	2,454				2,454	2,505
Yuba	26,132	3				3	26,135
	38,630	3,329,530	175,870	82,267	2,926	3,590,593	3,629,223
Total, 1920	29,900	[e] 1,243,971	179,752	252,704		1,676,427	1,706,327

[a] Counties combined to avoid disclosure of individual output.
[b] Includes 651 ounces from siliceous gold ore and 22,433 ounces from siliceous silver ore.
[c] Includes 2,331 ounces from siliceous gold ore and 1,526 ounces from siliceous silver ore.
[d] Includes 9,056 ounces from siliceous gold ore and 3,196,054 ounces from siliceous silver ore.
[e] Includes 1,122,912 ounces from silver ores.

COPPER.

All the larger copper mines of the State remained closed during 1921 except the Engels, in Plumas County. The copper ore worked in the State during the year amounted to 306,134 tons, with a total yield of 11,743,404 pounds of copper, valued at $1,514,899. These copper ores yielded also 1,439.01 fine ounces of gold and 175,870 fine ounces of silver.

LEAD.

Most of the lead produced in California in 1921 came from Inyo County, but small quantities were produced in Mono, Orange, San Bernardino, and Shasta counties. The lead ore yielded also 806.93 fine ounces of gold and 82,267 fine ounces of silver.

ZINC.

The mine production of recoverable zinc in California in 1921 came entirely from Shasta County. With the zinc was recovered 50.99 ounces of gold and 2,926 fine ounces of silver.

PRODUCTION BY COUNTIES.

AMADOR COUNTY.

Amador County led the other Mother Lode counties in quantity of siliceous ore, the output being 309,899 tons, or 88,952 tons more than in 1920, when two of the larger mines were closed down part of the time. Plumas was the only county that exceeded Amador County in production of ore, but this was due to the extensive operations of the Engels copper mine. In output of gold Amador was outranked by both Yuba and Nevada counties, but it led the other Mother Lode counties. The gold produced in Amador County in 1921 was valued at $2,167,443, or $378,650 more than in 1920. Of this 1921 gold $2,030,631 was from deep mines and $136,812 from placers. The silver output of the county was 35,460 ounces. The mines reporting production in the county in 1921 numbered 31, of which 8 were placers.

All the ore mined and treated in the county was siliceous and averaged $6.66 per ton in gold and silver, including the ore milled and tailings treated. Gold and silver mills treated 279,049 tons of ore, which yielded $1,465,656 in gold and $14,876 in silver saved as bullion; and 5,535 tons of concentrates were obtained, which yielded $473,388 in gold and $5,405 in silver. The total value of the milling ore was $1,959,325 in gold and silver, or $7.02 a ton. The 30,850 tons of old tailings re-treated yielded $91,587 in gold and $14,411 in silver, a total of $105,998. The placer gold of the county was valued at $136,812, or $43,265 more than in 1920.

At Amador City the Bunker Hill Consolidated Mining Co. is a large producer but was not in operation full time. The leading mine at this point is that of the Treasure Mining Co., which is developed by an inclined shaft of 1,600 feet and a winze that was sunk from 870 feet to a depth of 1,370 feet in 1921. The mine is equipped with a ball mill of 120 tons capacity for amalgamation

and concentration. A few smaller mines near Amador City and at Drytown and Ione were productive. The Amador Queen No. 2, at Jackson, the principal mining center of the county, was worked under lease. The Argonaut Mining Co., at the same place, was the largest gold producer in the county. This mine is operated through an inclined shaft 4,875 feet deep, and the principal development in 1921 was on the 4,800-foot level. The mine is equipped with a 60-stamp amalgamation and concentration mill. The California Slimes Concentrating Co. works the tailings of the Argonaut mine just as they come from the mill and has a 225-ton regrinding, amalgamating, and cyanidation plant. The Kennedy mine resumed mining and milling operations in September, after being closed for 18 months on account of a fire in the underground workings. The vertical shaft in this mine is 4,155 feet deep, and the ore is treated in a 100-stamp amalgamation and concentration mill. Hamilton, Beauchamp, Woodworth (Inc.), worked old tailings from the dump of the Argonaut mine, introduced into a 125-ton cyanide plant by combined hydraulicking and pumping. Considerable gold is obtained from numerous small mines in the vicinity of Jackson or brought there for sale from other points in Amador or neighboring counties. Small quantities of gold were derived from the Mountain King mine, at Pine Grove, and the Humphreys, at Plymouth. The Plymouth Consolidated Gold mines, at Plymouth, were operated the entire year. The inclined shaft on this property is 3,455 feet deep, and 5,267 feet of development work was accomplished in 1921. The company has a 30-stamp amalgamation and concentration mill with regrinding. Six Deister Flat-O tables have replaced 15 vanners in this mill. At Sutter Creek the Central Eureka Mining Co.'s mine and mill operated throughout the year and the pumps and hoist at the South Eureka operated to handle water from the two mines. The South Eureka is not producing but is held under option by the Central Eureka. The latter property is opened by a vertical shaft 4,100 feet deep and drifts at intervals of 150 feet. The shaft was sunk 200 feet deeper in 1921. At Volcano the Defender and Velvet mines made some output of gold.

Among the few placer mines of Amador County the Wicker, at Ione, and the Ludekens hydraulic, 2 miles from Pine Grove, were productive. The Ludekens operated for six months. A number of small placers near Plymouth yielded some gold. The Elephant hydraulic mine and the Humbug, Mat White, and other small placers around Volcano were productive. Two dredges were operated for 4 months and 7 days on the Amador County side of Mokelumne River by the American Gold Dredging Co., and for part time on the Calaveras County side.

BUTTE COUNTY.

The total output of gold in Butte County in 1921 was $456,760, of which $452,150 came from placers of various kinds, including $420,017 from 4 dredges, $3,328 from 1 drift mine, and $28,805 from 8 surface placers. The Spring Valley and Bonanza King deep mines made an output of $4,610 in gold and $82 in silver.

Mine production of gold in Oroville dredging district, Calif., 1912–1921.

Year.	Production.	Increase or decrease.	Year.	Production.	Increase or decrease.
1912	$2,080,229	+$92,935	1917	$717,782	−$252,627
1913	1,918,050	−162,179	1918	527,410	−190,372
1914	1,422,407	−495,643	1919	282,844	−244,566
1915	1,171,315	−251,092	1920	367,256	+84,412
1916	970,409	−200,906	1921	360,689	−6,567

On Butte Creek, 4 miles from Chico, the El Oro Dredging Co. operated steadily for eight months. In the Oroville field proper the American Gold Dredging Co. worked one dredge and the Natomas Co. of California, two dredges. The Steiffer drift mine, at Coutolene, under lease to the Evening Star Mining Co., was operated for seven months. Numerous small placers of different kinds produced considerable gold at or near Chico, Enterprise, Forbestown, Nimshew, Oroville, and Sterling City. The gold purchases at Oroville were particularly large, gold being brought there for sale from different parts of the county and doubtless some also from mines in adjoining counties. Most of this gold is purchased in small lots from individuals working their own or leased claims.

CALAVERAS COUNTY.

Calaveras, one of the Mother Lode counties, produced 13,714 tons more ore in 1921 than in 1920, and as the output in 1920 was 32,389 tons less than in 1919, an upward trend may be noted. The total yield of gold in 1921 was $1,495,758, or $56,013 more than in 1920. The value of the silver produced was $10,232, or $6,469 less than in 1920. No copper was produced in the county, the mines remaining closed throughout the year. The mines reporting production from the county in 1921 numbered 34—19 placer mines (11 sluice, 5 drift, and 3 dredges) and 15 deep mines (all producing siliceous ore). Dredges recovered $164,079 in gold, or $61,701 less than in 1920; drift mines, $17,798, or $16,558 more; and surface placers, $4,548, or $2,759 more.

The total quantity of ore sold or treated in Calaveras County was 204,866 tons, which yielded gold valued at $1,309,333 and silver valued at $9,574. The placer output was $186,425 in gold and $658 in silver. The total value of the output of the county in gold and silver was $1,505,990. During the year 204,866 tons of ore was treated at gold and silver mills and yielded $952,743 in gold and $6,635 in silver. From this milling ore was obtained 6,333 tons of concentrates, yielding $356,590 in gold and $2,939 in silver. The value of the total gold and silver recovered from the ore was $1,318,907, or $6.44 a ton.

No large mines are now being operated at Angels, but considerable gold finds its way there from the surrounding country, where numbers of small mines are worked. The Finnegan mine, of the Carson Hill Gold Mines Co., is a considerable producer at Carson Hill. The Royal, at Felix, is operated by the Texas California Mining Co. A small quantity of gold was obtained by lessees from the Bachman pocket mine, at Fourth Crossing. The Carson Hill Gold Mines (Inc.),

at Melones, has the most productive mining property in the county, and operated full time in 1921. This mine is developed by an 800-foot vertical shaft and 21,000 feet of drifts. The company did 7,745 feet of development work in 1921 and has rented from the Melones Mining Co. a 6,700-foot adit tunnel, a 2,400-foot shaft, and a 1,000-foot winze. The mine is equipped with a 30-stamp amalgamation and concentration mill, with regrinding in Hardinge mills. The Morning Star, at Mokelumne Hill, and the Comet & Towles, at Railroad Flat, are productive. The Sheep Ranch mine, at Sheep Ranch, owned by the Montacali Mines Syndicate, is developed by an incline 1,730 feet deep and 5,335 feet of drifts in the present area of operations, and considerable work was done in 1921, during which the company changed from the shrinkage to the fill system of stoping. The property has a 100-ton cyanide plant for treating the ores. The Bullion Hill (formerly the Washington), at the same place, is owned by the Bullion Hill Mining Co. and has a 5-stamp concentration mill installed in August, 1921. The mine was operated intermittently from August to the end of the year. The Columbus mines, at West Point, started operating October 1, 1921, and has a 20-ton Gibson mill and concentrator.

The most productive placers of the county were worked by the American Gold Dredging Co., at Camanche, and the Ivy L. Borden dredge, at Jenny Lind. The American Gold Dredging Co. had two dredges, which worked 6 months and 14 days, and the Borden dredge was worked the full year. There are some small placers near Mokelumne Hill, Jenny Lind, Mountain Ranch, Valley Springs, and West Point.

The Union Shaft is a drift mine of the Central Hill Mining Co. at San Andreas, and there are some surface placers in the same vicinity. At North Branch the Herpides Mining Co. is working in Calaveras River. The drift mine of the Vallecito Consolidated Mines Co. is at Vallecito.

ELDORADO COUNTY.

Eldorado, one of the five Mother Lode counties of California, made a total output of $34,410 in gold and silver in 1921, which is an increase of $20,876 over that of 1920. The deep-mine gold of the county was valued at $28,549 and the placer gold at $5,560. The total silver yield was only $301. Of the 29 mines that reported production, 20 are deep and 9 placers. Among the deep mines are the Craig & Jauch, at Clarksville; Gray, Havilah, Reliance, and other smaller ones, at Eldorado; Morning Star and Lucky Boy, Pacific, Sailor Slide, Struman, and other small quartz mines at Georgetown; Argonaut, Grit, Golden Unit, and others at Greenwood; Lucky Strike and Humbug, at Grizzly Flats; Sugar Loaf, at Shingle; and Hines-Gilbert and other small mines at Placerville.

The productive placers of Eldorado County in 1921 were small mines at Diamond Springs, Shingle, Georgetown, and Omo Ranch; the Hope drift mine and sluicing mines at Placerville; and the Hook and Ladder and smaller sluice mines at Smith Flat.

INYO COUNTY.

The mines reporting production from Inyo County in 1921 numbered 22, about half the number operating in 1920. Of these mines, all of which were deep, 11 were gold or silver (including 2 that produced silver exclusively) and 11 were lead. The total value of the metallic output of the county was $218,938, or $558,755 less than in 1920. The value of the gold was $80,373, or $24,739 more than in 1920. The silver amounted to $86,020, as compared with $258,929, a considerable decrease, due to the fewer number of mines worked in 1921 as well as to the lower price of silver. The output of copper was 42,233 pounds, valued at $5,448, as compared with 131,630 pounds, valued at $24,220, in 1920. The output of lead was 1,046,609 pounds, valued at $47,097, a decrease of 3,560,907 pounds in quantity and $321,504 in value. Inyo County is usually the largest producer of lead in the State and continued so in 1921, notwithstanding the marked decrease in output, which is indicative of the general condition of the lead-mining industry of California. Inyo County produced 868,009 pounds of zinc in 1920, but none in 1921.

The ore sold or treated in 1921 in Inyo County amounted to 12,344 tons, of which 9,718 tons was siliceous ore and 2,626 tons was lead ore. Of the gold produced $64,167 was obtained from siliceous ore, and $16,206 from lead ore. The production of silver from siliceous ore was 23,084 ounces and from lead ore 62,936 ounces. Included in the siliceous ore was 67 tons of siliceous silver ore from 5 mines, yielding $22,433 in silver.

At Big Pine the Cometti, Blue Monster, and Lincoln Silver Mines Corporation produced mainly silver, with a little lead. The Bishop Creek Milling Co., working the Wilshire gold mine, at Bishop, has a 100-ton concentration mill, the concentrates from which were shipped to the Midvale smelter, Utah. The developments in this mine consist of a shaft 286 feet deep, 800 feet of drifts and crosscuts on the first level, and 900 feet on the second level. Considerable drifting was done on both levels in 1921. The mine and plant were operated from July 1 to the end of the year. The Maltby, at the Bishop, produced silver only, and the Vanderberg and the Ubehebe mines each produced silver, copper, lead, and a little gold. The Blue Bell, at Darwin, is a small gold mine. The Darwin Silver Co., Snow Canyon, and Towser produced silver mainly, with a little gold and a small quantity of lead. The output from the Yucca, which was worked for six months, was mainly gold. The small output of the Cerro Gordo Mines Co., at Keeler, was mainly silver and lead, with a little gold. The Estelle Mining Co., 5 miles east of Keeler, operated only with a skeleton crew throughout the year, owing to the high freight rate on ore to smelter and the high cost of supplies and materials. The ore shipped carried gold, silver, copper, and lead. From the Santa Rosa mine, of the Santa Rosa Lead & Silver Mining Co., was shipped silver ore that carried some lead and copper. The ore came from open cuts, shallow shafts, and tunnels in various parts of the property. High costs and low price of lead caused only a small force of men to be employed. The Golden Treasure group, also known as the Ashford Brothers mine, is on the west slope of the Amargosa Mountains, at the south end of Death Valley. General development work was done there during the year, including prospecting for water, building

houses, and installing machinery and equipment at the mines and mill. The mine was worked all the year, but the mill ran only in June. A 10-foot Lane mill is in use, with Wilfley concentrators and Diester slime tables. The shipping point is Shoshone. At the same place some shipments of silver ore were made by small mines, and the Paddy Pride Mining Co. shipped silver ore carrying both lead and copper, installed an air pipe from the 700-foot level, and built a new road during the five months the mine was worked. Some lead-silver ore was shipped from Trona by the Overland Nos. 1 and 2, at the head of Nemo Canyon, in the Wild Rose district. The Copper Queen mine, of the Slate Range Minerals Co., was worked for a few weeks early in the year by the Walker Leasing Co., and the concentrates produced were shipped from Trona to the Midvale smelter. The principal output was in silver, but there was considerable gold in the ore and some lead. There is a 50-ton concentrating mill at this mine. The Radcliffe Mines Co. shipped a little ore from the Salvage group. The mine of the Stockwell Gold Mining Syndicate, in the Slate Range, was worked all the year, but the 7-foot Lane mill was run only part of April and May. The product was almost entirely gold.

KERN COUNTY.

Of the 27 mines that reported production from Kern County in 1921, 24 were deep mines and 3 placers. The total metallic value of the output increased from $69,572 to $86,595—$84,698 in gold and $1,897 in silver. The ore treated amounted to 11,559 tons, all siliceous, of which 11,548 tons was treated at gold and silver mills and 11 tons shipped to smelters. The yield of bullion from the milling ore was $81,363 in gold and $1,682 in silver; from 27 tons of concentrates the recovery was $1,454 in gold and $145 in silver. The 11 tons of ore smelted yielded $620 in gold and $53 in silver. The placer mines worked at Kernville, Randsburg, and Weldon produced $1,261 in gold and $17 in silver.

The Maid of the Mist is a small producer at Brown. The Glen Olive, at Bodfish, operated the full year, but the 10-stamp amalgamation mill was run for only seven days. This mine is opened by an adit 500 feet long, and some winzes and raises were made from this tunnel in 1921. The Gwynne and Royal Flush mines are small producers near Caliente; at the Royal Flush the ore is crushed in an arrastre. A little gold came out of the old Keyes and Pennsylvania mines at Isabella. At Johannesburg the Shipsey Mining Co. leased the King Solomon mine to the King Solomon Mining Co., and a small quantity of gold ore was treated in the 5-stamp mill early in the year. At the Narragansett mine, at Kernville, equipped with a 10-ton Nissen stamp mill, some development work was done during the year and a small quantity of gold was produced. The Way mine, at Mojave, which has a Gibson prospector's mill, made only a small output. The Old Elephant, at the same place, owned by the Elko Gold Mining Co., is developed through two shafts, 120 and 220 feet deep, and has a 40-ton Herman grinding mill, amalgamating plates, and cyanide plant. In Mascot Gulch, 9 miles west of Randsburg, Alderson & Bopp put up new hoisting works. The Baltic mine and 5-stamp mill, at Randsburg, was worked under lease to F. Bacon. In November the Pittsburg & Mount Shasta

Mining & Milling Co. started work on the Black Hawk mine, which is equipped with a 5-stamp mill. The Butte mine was worked by lessees and some development work was done, though little ore was treated in the 10-stamp amalgamating mill. Small quantities of gold were produced by the Confidence & Maganetta, Buckboard, San Diego & Rustler, Sidney, Payday, and other small mines at Randsburg. The principal mine at that camp, the Yellow Aster, was worked by lessees during the year. At Rosamond the Tropico Mining Co. has a 10-stamp amalgamation mill and a 30-ton cyanide plant. The Blue Mountain gold mine, at Woody, was developed throughout the year, and the 10-stamp amalgamation and concentration mill built in 1921 was operated for three months.

MADERA COUNTY.

Only five mines reported production from Madera County in 1921, 3 deep and 2 placers. The total value of the output of these in gold and silver was $1,080, of which $444 was from the deep mines, comprising the Bolivia, at Coarsegold, Swastika, Gold Run, and Little Maggie, at Knowles, and small mines near Madera. The total county output was $23,291 less than in 1920, mainly because no copper was produced in 1921.

MARIPOSA COUNTY.

Mariposa, one of the Mother Lode counties of California, made a total metallic output valued at $336,546 in 1921, an increase of $70,011 over the total in 1920. Of the 19 mines reporting production, 12 were deep gold mines, which produced $323,958 in gold and $5,171 in silver; and 7 were placers, all surface or sluicing, which produced $7,337 in gold and $80 in silver.

The deep mines of the county produced 30,577 tons of siliceous ore, all of which was milled and yielded $290,834 in gold and $3,412 in silver as bullion. From this ore was derived 699 tons of concentrates, which yielded $33,124 in gold and $1,759 in silver. These concentrates were shipped to smelters.

The Jumper mine on Bear Valley Mountain near Bagby, was operated 290 days, and a barrel mill with a capacity of 100 pounds of ore per hour was installed. The Winner, at Briceburg, made only a small output. The Original Mining & Milling Co., at Clearinghouse, operated the Original mine, which is the most productive in the county. This mine is developed through a 786-foot inclined shaft, 8,160 feet of drifts, and an adit 175 feet long. The equipment consists of a 10-stamp amalgamation and concentration mill. The power line of the San Joaquin Light & Power Co., from Kittredge to Clearinghouse, was completed in November, and the Original mine and mill now use this power. Cuneo Bros. took out some gold at Coulterville, but the most productive mine at that place is the Virginia, owned and operated by the Virginia-Belmont Mining Co. The inclined shaft was sunk from 700 to 900 feet, and drifting to the extent of 1,164 feet was done in the 900-foot level. The milling plant consists of 10 stamps, 2 vanners, and a 3-foot Hardinge mill. The Noce-Frazer pocket mine and the Feretti, at Coulterville, were both small producers, as were the Number 5 and Ruth Pierce, at

Hornitos. The Bryan Silver Mines, at Mariposa, retimbered the shaft and put in tracks. The reduction plant at this mine consists of a 40-horsepower Union gas engine, 5-foot Huntington mill, 1 Marathon mill, and Diester and Eccleston concentrators. The mine of the Mountain King Mining Co., at Mountain King, is opened by a 1,000-foot crosscut to the vein. Drifting was carried on during the year. The equipment consists of a 30-stamp amalgamation and concentration mill. The placer mines reporting were all small ones, worked intermittently, at or near Bagby, Coulterville, Hornitos, Mariposa, and Mount Bullion.

MONO COUNTY.

The total value of the metal output from 10 mines in Mono County decreased from $186,791 in 1920 to $54,377 in 1921. The gold alone decreased $106,992. The yield of silver was 15,160 ounces in 1921, compared with 31,531 ounces in 1920. Only small quantities of copper and lead were produced in 1921.

The crude ore treated at gold and silver mills amounted to 2,072 tons, which yielded $19,121 in gold and $1,252 in silver. The 8 tons of concentrates treated yielded $1,363 in gold and $580 in silver. To the smelters 149 tons of crude ore was shipped, yielding $12,381 in gold, $13,273 in silver, 2,195 pounds of copper, and 26,233 pounds of lead. There were 500 tons of old tailings treated which yielded $4,889 in gold and $55 in silver.

A small quantity of ore was shipped to the Midvale smelter, Utah, from the Blonde Esquimo mine, at Benton. The Blind Spring Hill Co. worked the Cornucopia and Protection mines at Benton, producing principally silver with some copper and less gold. The principal yield of the Quail group at Benton, worked by lessees, was in silver. Several lessees worked on the Standard mine at Bodie and made considerable output. This old mine is equipped with a 20-stamp amalgamation and concentration mill and a 100-ton cyanide plant. At the Golden Gate mine at Colville, owned by the Diamond Creek Development Co., several hundred feet of drifts, crosscuts, and raises were opened. The company has a 10-stamp amalgamation and concentration mill. A lease on the Chemung mine, of the Masonic Mines Association, was productive, and several hundred feet of drifting, raising, and stoping was done during the year. The Serita and a few other mines at Masonic produced in a small way. At Mono Lake the Double Eagle made a small output.

NEVADA COUNTY.

Nevada County, in 1921, was first in rank among the gold-producing counties of California in the yield of gold from deep mines, being exceeded only in total gold output by Yuba County, which owed its supremacy to the unprecedented yield from gold dredging. Production was reported from 32 mines, 10 placers and 22 deep mines. Among the latter was the most productive single gold mine in the State. The word "single" is used in this connection because the gold dredging companies, some of which run 8 or 10 dredges, combine the yield of all in reporting, whereas each dredge is virtually a separate unit in point of production. There were 6 drift mines, 1 hydraulic, and 3 surface placers. The total value of the output of metals from

Nevada County was $2,604,068, of which $2,570,162 was gold and $33,906 silver. As compared with 1920 there was a decrease of $302,309 in gold and $24,570 in silver.

The deep mines produced $2,529,770 in gold, or $330,787 less than in 1920, and the yield of placer gold was $40,392, or $28,478 more than in 1920. The value of silver from deep mines was $33,713, and from placers, $193.

The total quantity of ore produced was 199,678 tons, or 64,935 tons less than in 1920. This ore yielded $2,529,770 in gold, or $12.67 a ton, and $33,713 in silver, or $0.17 a ton, a total value of $12.84 a ton. The average value was $11.03 a ton in 1920 and $9.56 in 1919.

Gold and silver mills in Nevada County treated 199,677 tons of ore in 1921, recovering $2,524,313 in gold and $33,605 in silver as bullion. Only 73 tons of concentrates were shipped or treated separately; they carried $5,271 in gold and $103 in silver. As mentioned in previous reports, the explanation of this apparent anomaly is found in the modern practice in milling in this country, by which after the ore is crushed under the stamps and the sulphurets are concentrated, the concentrates are reground in tube mills and added to the tailings and the whole is cyanided, the operation being continuous. The former method of separating the concentrates and shipping them to a smelter for reduction is not followed, except to a small extent. The reports received from the chief producers do not now give separate quantities and values of the concentrates, as they did when the sulphurets were saved and shipped for separate treatment. Only one ton of test ore was shipped to a smelter, yielding $186 in gold and $5 in silver.

Grass Valley is the principal mining center of Nevada County and the most productive deep-mining gold camp in the State. The number of separate producing mines, however, is not nearly so great as formerly, largely owing to the consolidation into companies owning a number of individual mines under one corporate name, and the fact that others have been idle or worked only intermittently during the last few years since the World War.

The Kenosha mine, of the Alcalde Gold Mines Co., of Grass Valley, is equipped with a 10-stamp amalgamation mill. Drifting, raising, and prospecting were carried on in 1921, and some gold was produced. The drifting was done preparatory to raising a vertical shaft. The Empire Mines, owning a number of separate locations, including the Pennsylvania and W. Y. O. D., was the most productive deep gold mine operator in the State. The Allison Ranch mine, owned by the Grass Valley Consolidated Gold Mines Co., has been closed indefinitely after making a small production. The Idaho-Maryland Mines Co., owning a number of separate claims, has a 20-stamp mill with Diester concentrating tables and ships its concentrates to a smelter for treatment. A great deal of development work was done in 1921, including unwatering and repairing inclined shafts, winzes, raises, drifts, and crosscuts. There was considerable production. The North Star mine, one of the oldest and largest producers of the State, is developed through a vertical shaft 1,600 feet deep and an inclined shaft 6,300 feet long. Developments in 1921 consisted of raising 2,237 feet and drifting 3,400 feet. The 60-stamp mill and 350-ton cyanide plant averaged 65 per cent of full capacity during the year. At this plant the ore is crushed under

stamps and the sulphurets are concentrated and reground in tube mills; they are then added to the tailings, and the whole is cyanided. As this is one of the few representative mines of the State, operated on a large and modern scale, which publishes an annual report, it is possible to obtain officially some of the data on costs of deep mining for gold and average value of ores treated.

During the first six months of the year, as in the latter part of 1920, the North Star mine was operated on a limited scale, stoping being confined to selected areas and the mill running at one-half capacity. For this period the average yield per ton was $16.17 and the cost per ton of operating and development $11.60. This method of operation, tending to deplete the mine of all the ore of better than average quality, while leaving unmined the quartz of lower grade, could not be continued permanently. In July, pending adoption of a lower scale of wages, without which operations must have been suspended indefinitely, the mine was closed down for several weeks. In August, upon acceptance by the miners of the reduced rate of wages proposed, operations were resumed and gradually increased in scale until the mill was operated at full capacity. During this latter period, while the quartz milled was of lower grade and more representative of the general average tenor of the ore now available in the mine, the cost of operation and development was reduced to about $8 per ton.[1]

The gross production of the North Star mine in 1921 was $922,769, and the expenses for current operation were $632,077, and for development $109,148, or a total of $741,226, leaving an operating profit of $181,543. Of a total of 99,945 tons of ore 76,000 tons was crushed (the rest being waste after sorting), with an average yield of $12.14 per ton crushed, at an average cost of $8.32 for operating and $1.43 for development, or an aggregate cost of $9.75 per ton crushed ($7.41 per ton mined), leaving a realized profit of $2.39 per ton crushed. To the extent that the labor situation has improved and that there has been some reduction in the cost of various supplies and of power, operating conditions are more favorable than they have been for several years past. A considerable decrease in cost per ton is expected when the mine is operated at full capacity. Of the total production 86.08 per cent was obtained in the mill by amalgamation, and 13.92 per cent was recovered by cyanidation. The value of the metals lost in tailings was only 26 cents per ton crushed. The operating expenses per ton of ore mined were $4.37; for milling, $0.513; for cyaniding, $0.371; for tailing disposal, $0.095; and for bullion, $0.025. From May, 1884, to the end of 1921 the ore produced has amounted to 2,201,310 tons, yielding $24,705,983, or $11.22 a ton; and the operating and development expenses have been $17,314,919, or $7.87 a ton. The profit has been $7,391,063, or $3.35 a ton, out of which dividends of $5,662,040 have been paid.

The Sultana Mining Co. did mainly development work during the year, but some ore was crushed in the 20-stamp mill. A great deal of gold was obtained from small mines in and about Grass Valley.

At the Mayflower mine, Nevada City, the Grunman shaft was sunk on a 45° incline to the 400-foot level, and some ore was taken out between the 300 and 400 foot levels. The 20-stamp mill was operated only for three months. The Mulcahy Ledge, owned by the Newton Mining Co., was prospected by drifting, and the 10-stamp mill was operated a short time only. The Queen Lil mine was operated from January to October. The ore is dried and pulverized in a crusher and then placed in an amalgamating pan. A great deal of gold is purchased at Nevada City from small miners.

[1] North Star Mines Co., Ann. Rept., 1921.

Small quantities of gold were recovered from the Jersey Cow mine, at Rough and Ready; the Penrose, at Washington; and the Gold Bug, near Emigrant Gap. The Gold Bug mine uses a 5-ton arrastre. The Quaker Hill drift mine, owned by the Quaker Hill Gold Mining Corporation, is in the Quaker Hill district, near Nevada City. The You Bet and Red Dog, on Greenhorn and Steep Hollow creeks, in the You Bet district, is worked by drifting. This property is being developed, and a dam is being constructed for hydraulicking. Some small mines were worked by drifting and sluicing at North Bloomfield, Grass Valley, and North Columbia. At the Lucky Strike, near Washington, the gold nuggets mined come from crevices in the bedrock. The You Bet mine of the California Placer Mines Co., at You Bet, is worked by the drifting system; and the Liberty Hill mine, on Bear River, is a hydraulic property, operated by William Maguire.

PLACER COUNTY.

The total value of metals produced in Placer County in 1921 was $133,536, of which $132,468 was in gold and $1,068 in silver, a decrease in total value, as compared with 1920, of $19,730. Of the 34 mines reporting production 1 was a dredge, 16 were drift mines, 8 surface placers, and 9 deep-gold mines. The production of gold from deep mines was $47,928 and from placer mines $84,540, a total decrease of $18,620, compared with 1920. Deep mines produced $587 in silver and placer mines $481, a decrease in total silver of $1,110.

The ore mined in Placer County amounted to 7,712 tons, all siliceous and all treated at gold and silver mills. Of the gold and silver recovered in milling $46,915 in gold and $505 in silver were saved as bullion, and $1,013 in gold and $82 in silver were recovered from the 19 tons of concentrates treated.

Of the gold won by placers $24,884 came from 16 drift mines, $13,971 from 8 sluicing mines, and $45,685 from dredging operations.

At the Oro Fino Mining Co.'s property, at Auburn, practically all work done in 1921 was development work, and barren rock was struck. The intention was to sink to a lower level, but on the death of the manager the mine was closed. The Rising Sun, at Colfax, and the Dry Hill and Blue Jay, at Foresthill, yielded small quantities of gold. At the Johnny Rafael mine 350 feet of tunnel was run. The gold came from pockets and seams. Very little was done at the Reno Consolidated mines, at Foresthill, or at the Daniel Webster, Champion, and New Hope, at Michigan Bluff. The Pioneer Gold Mines Co., at Towle, the only deep-mine producer of note in the county, did not begin operating the mine and 20-stamp amalgamating mill until August, and only stoping was done in the mine. The Pacific Gold Dredging Co. operated a dredge on the North Fork of American River, near Applegate, for eight and one-half months. Considerable placer gold was bought in Auburn from small mines in that section of the county. The Haub mine drifted in an ancient river bed near Blue Canyon for about six months, and small quantities of gold came from the Lost Camp and other mines around Blue Canyon. The Acacia, American Hill, Baltimore Canyon, and other small mines around Foresthill produced some gold. The Paragon drift mine in Volcano Canyon, Bath mining district, recovered some gold

in the course of development work. The Juno, the New Zealand, and the Jupiter mine of the McGeachin Placer Mining Co., at Iowa Hill, were productive drift mines. The Glenn Consolidated Gold Mines, operating on Duncan Creek, Last Chance district, Michigan Bluff post office, owns the most productive drift mine in the county and worked it the entire year. The Last Chance and other small drift mines at Michigan Bluff were productive. Reeves & Rogers, under agreement with the Roseville Placer Mining Co. at Roseville, worked cemented gravel from an ancient river bed for about two months, crushing the gravel in a Beers mill, with plates and sluice boxes. A little gold came from the Dorer, in Humbug Canyon, near Towle, and other mines in that section.

PLUMAS COUNTY.

The total value of all metals produced in Plumas County in 1921 was $1,792,502, or $224,523 less than in 1920. The production was distributed as follows: Gold, $127,148; silver, $171,090; copper, $1,494,264. Ten deep mines produced $89,984 in gold, $170,913 in silver, and 11,583,441 pounds of copper. The 2 hydraulic mines yielded $2,646 in gold, 13 drift mines $32,269, and 13 surface or sluicing mines $2,249, a total of $37,164, or $21,490 more than in 1920. The placer silver was valued at $177. The output of copper was 2,004,336 pounds more than in 1920.

In 1921 the ore treated in the county amounted to 321,723 tons, as compared with 289,856 tons in 1920. It comprised 306,037 tons of copper ore and 15,686 tons of siliceous ore. The siliceous ore milled carried $59,100 in gold and $636 in silver, or an average of $3.81 a ton. The copper ore had a value of $1,694,009, or an average of $5.54 a ton. Of the copper ore 306,024 tons was treated by flotation concentration and yielded 19,850 tons of concentrates. The 13 tons of copper ore sent to a smelter yielded $21 in gold, $488 in silver, and 2,614 pounds of copper, valued at $337.

The Engels Copper Mining Co., at Engelmine, was much the largest producer in the county, as it is the largest copper producer in the State. The mines are developed by adits and shafts, and 8,637 feet of development work (including diamond-drill footages) was done during 1921. The property is equipped with a 1,200-ton concentrating plant, using the oil-flotation process, and the concentrates are shipped to the smelter at Garfield, Utah. In the Engels mine 90 per cent of the work done was development work preparatory to stoping. In the Superior mine only such development work was done as was needed to produce the greatest quantity of ore at the least expense. Operations continued throughout the year. The 306,024 tons of ore treated averaged 2.22 per cent of copper, the actual extraction being 84.48 per cent. The average assay value of the concentrates was $29 a ton. During the year the ore reserves have been increased to 3,342,118 tons, or 47 per cent, even after deducting the ore sent to the mill, and the expense of shutting down has been avoided. A reduction in operating costs of 3.49 cents a pound of copper has been effected. The net cost of copper production was 14.69 cents a pound. The net receipts from concentrates delivered to and in transit to the smelter, together with other earnings, was $1,037,388.97. The total operating expense was $1,088,555.34,

leaving an operating deficit of $51,166.37. Reserves for depreciation and liability for compensation, less profit and loss, December 31, 1920, and stock premium bring the total deficit up to $119,616.73 for the year. Capital expenditures for 1921 amounted to $275,468.86.

The mine of the Gruss Mining Co., at Genesee, is opened by a 400-foot vertical shaft and 1,000 feet of drifts. The development work in 1921 consisted of drifting, stoping, and open-cut and quarry work. There is a 10-stamp amalgamation and concentration mill on the property, and a ball mill was added during the year. The Long Valley Mining Co., at Greenville, ran some drifts, cuts, and trenches. There is a 5-stamp mill on this property. Lessees on the mines of the Jamison Mining Co., at Johnsville (now owned by the Plumas-Eureka Annex Mining Co.), mined considerable good ore. The Plumas-Eureka, at Johnsville, is one of the oldest of the deep mines of the State and was worked the entire year, although the 20-stamp amalgamation and concentration mill was run only for 19 days. The property is opened by an adit 7,300 feet in length. The Trask & Coffer Mining Co. did not operate the Beetle or Moonlight mines, at Paxton, although it shipped a little ore. Lessees on the White Lily mine of the Seneca Consolidated Gold Mining Co., at Seneca, took out a few thousand dollars in gold.

No especially large placer-mining enterprises are now being carried on in Plumas County. The Caribou, Hetty Jane, Trippe, and other small placers were producers near Belden, and the Cadmus, at Crescent Mills, was worked about a month. Placers at Greenville yielded a few thousand dollars, and the Continental, Grendona, and Red, White, and Blue were producers near Johnsville. On the South Fork of Feather River, 10 miles north of La Porte, the Feather Fork Gold Gravel Co. worked its drift mine for five months of underground operations. The Maxine drift mine was productive at La Porte. At Meadow Valley the old Rutherford made a small production, with 50 days water for ground sluicing. On Little Grizzly Creek, 10 miles from Genesee, the Little Grizzly Placers hydraulicked for a short time. The Australia Placer Mining Co. did hydraulic mining on its claim near Quincy, and 12 miles from there the Willow Creek Mining Co. worked the New Hope mine, sluicing with a self-acting reservoir. At Quincy the Crown Point, Schley, and other small mines were worked, some by the "shooter" system. The Independent, Sunnyside, and Yankee Bar were producers near Seneca. Some placer gold was taken out at Spring Garden. The Twelvemile Bar, on the east branch of the North Fork of Feather River, near Twain, was drifted.

SACRAMENTO COUNTY.

Sacramento was fourth in rank among California gold-producing counties in 1921, this high rank being entirely due to the extensive dredging activities. The total gold output of the county was $1,690,662, which is an increase over 1920 of $115,629. The Natomas Co. of California operated seven dredges in what is known as the Folsom field for the entire year. The total material dredged was 21,253,288 cubic yards, resulting in a profit of $292,529. It is estimated that the remaining proved dredging ground of the company, at present costs, contains 125,600,000 cubic yards, sufficient for 10 years' operation. Considerable platinum and osmiridium was obtained during the dredging operations. At several points around Folsom and Blue

Ravine small quantities of gold were obtained in drift and sluice mining by individual miners. The silver output of the county was valued at $5,254, and the total yield in gold and silver was $1,695,916.

SAN BERNARDINO COUNTY.

The total value of all metals produced in San Bernardino County in 1921 was $3,431,366, or $2,133,105 more than the total in 1920. This is a larger increase in value than is shown by any other county in the State and brings San Bernardino to second rank, Yuba being first. This increase is due amost entirely to the large silver output of the California Rand Silver (Inc.). That mine and the Grady-Sill-Jones lease on Uranium No. 5 claim of the same company are the most productive silver properties in the State. The silver derived from siliceous ores amounted to 3,205,110 fine ounces, from copper ores 62 ounces, and from lead ores 5,530 ounces. The increase in the value of silver alone in San Bernardino County was $1,997,719. There was also a gain of $138,373 in gold and $1,827 in copper. The lead production, however, fell off 49,801 pounds in quantity and $4,814 in value. Deep mines yielded $217,175 in gold, $3,210,702 in silver, 15,702 pounds of copper, valued at $2,026, and 23,694 pounds of lead, valued at $1,066. No zinc was produced in the county in 1921.

The ore from San Bernardino County treated in 1921 was 45,839 tons from 30 deep mines, of which 45,582 tons was siliceous, 36 tons copper ore, and 221 tons lead ore. Of the siliceous ore 38,506 tons came from 12 silver mines and yielded $3,196,054 in silver and $184,246 in gold. Four lead mines produced 221 tons of ore, which yielded 23,054 pounds of lead, $5,530 in silver, and $145 in gold. There are more silver mines in San Bernardino County than in any other county in the State, and the most productive are new mines opened within the last few years.

Gold and silver mills treated 4,765 tons of ore, yielding $26,479 in gold and $2,300 in silver as bullion; and 480 tons of ore was sent to concentrating mills and produced 17 tons of concentrates, from which was recovered $124 in gold, $2,226 in silver, and 4,313 pounds of lead. Crude ore shipped to smelters amounted to 38,593 tons, yielding $188,608 in gold, 3,200,837 ounces of silver, 15,702 pounds of copper, and 19,381 pounds of lead. Of old tailings 2,001 tons was treated, yielding $1,964 in gold and $5,339 in silver.

The Gateway, a new mine which made its first production in 1921, is half a mile from Fremont Peak and 14 miles from Atolia, in the Fremont district. The property is in process of further development. Roth Bros. worked mill clean-up and old tailings from the old Bagdad-Chase mine, near Barstow, by the cyanide process. The Gold Dollar, at Camp Baldy, near the head of Dry Gulch, a mile north of Cold-water Creek, had its ore crushed in a Gibson mill. The shaft in the mine is only 150 feet deep. Some lead-silver ore was shipped by J. L. Carden from Bagdad. Small shipments were made by lessees of the Dutch Silver mine and a few other claims near Cima. Silver ore was treated by the Dagget Reduction & Mining Co. at Dagget, and a few other mines there, including the American, Ontario, Red Jacket-King, and Sioux, produced small quantities of silver. The Sioux mine used a test cyanide plant for two months. A little silver

came from the Juanita group, at Ivanpah. The Carbonate, near Oro Grande (Halleck post office), shipped lead carbonate ore. The Gold Mountain, at Victorville, was operated four months, and the 40-stamp mill was changed to electric from steam power. Battery and plate amalgamation only are used, and the principal output was gold.

The California Rand Silver (Inc.) is developed by an inclined shaft 765 feet in depth and two vertical shafts, 323 and 400 feet, with 15,721 feet of crosscuts, drifts, and raises. The gangue in this mine is siliceous, and the oxidized ore extends to depths of 100 to 150 feet. The ore has been shipped to the Selby smelter, on San Francisco Bay, but the new 150-ton concentration mill was started in operation December 4, 1921. None of the concentrates were sold in 1921, and the results from them will appear in the report for 1922. The mine was worked the entire year. The Uranium No. 5 claim, owned by this company, was under lease to Grady, Sill & Jones and is better known as the Grady lease. It is opened by a 450-foot vertical shaft and 480 feet of drifts, and some 240 feet of crosscutting was done in 1921. The main product is silver, of which a large output was made—second only to the California Rand—but the ore carries considerable gold also. Other productive mines in this district are the Black Hawk and Blue Bird, and there are several which have or use no names. The White Elephant is a small producer near Johannesburg, in the Blackwater district. The Oriental-Red Cloud mine, at Yermo, was worked productively under lease.

The few small placers worked in the county in 1921 were all in the vicinity of Atolia.

SHASTA COUNTY.

The total output of all metals produced in Shasta County in 1921 was $339,680, or $130,927 less than in 1920. It consisted of gold, $267,681; silver, $5,581; copper, 99,833 pounds, valued at $12,878; lead, 14,500 pounds, valued at $653; and zinc, 1,057,731 pounds, valued at $52,887. The decrease in gold was $45,220; in silver $30,982; in copper 413,787 pounds in quantity and $81,628 in value. The zinc output increased 760,231 pounds in quantity and $28,790 in value. The decrease in total output of the county for the year is due to the continued idleness of the large copper mines and smelters and the closing down of a number of small gold and silver mines, which formerly sold their ores to the smelters.

The deep mines in Shasta County produced $24,915 in gold and the placer mines $242,766, an increase in gold from deep mines of $10,917 and a decrease in placer gold of $56,137, making a total gold decrease of $45,220. Of the gold produced from deep mines 1,151 ounces came from siliceous ore, 3 ounces from lead ores, and 51 ounces from zinc ores.

The output of silver was 5,581 ounces, of which 1,066 ounces came from placers and 4,515 ounces from deep mines. The 3,153 tons of siliceous ore yielded $23,799 in gold and 890 ounces of silver. The 47 tons of lead ores yielded $62 in gold, 699 ounces of silver, 700 pounds of copper, and 14,500 pounds of lead. The 2,953 tons of zinc ore yielded $1,054 in gold, 2,926 ounces of silver, 99,133 pounds of copper, and 1,057,731 pounds of zinc.

The ore from Shasta County mines treated in 1921 amounted to 6,153 tons, of which 3,153 tons was siliceous ore, 47 tons lead ore, and

2,953 tons zinc ore. Gold and silver mills treated 1,729 tons of siliceous ore, from which was recovered $20,392 in gold and 207 ounces of silver. There was 3,006 tons of ore shipped to smelters, which carried $1,157 in gold, 4,247 ounces of silver, 99,833 pounds of copper, 14,500 pounds of lead, and 1,057,731 pounds of zinc. Old tailings amounting to 1,418 tons were treated and yielded $3,366 in gold and 61 ounces of silver.

The 4 dredges in Shasta County produced $233,527 in gold and the 8 surface or sluicing mines $9,239 in gold.

The Independence is a pocket-seam mine 6 miles from Castella, the material from which is worked in a pan and rocker. Lessees took out ore from the Shasta Hills mine, in the French Gulch district, and milled it in the 5-stamp mill of the company. The Brown Bear ore was milled at a custom mill. The Washington mine, 4 miles from French Gulch, was worked only experimentally, but some gold was produced. Lessees worked the Milkmaid group, opening up old drifts and retimbering shafts, and some ore from the old dumps was milled in the 10-stamp mill. Several small mines in the French Gulch district made more or less gold output, and a little gold was produced at Igo and Ono. Considerable gold was brought into Redding from several small mines in that vicinity and sold. The only deep mine of any importance worked in Shasta County in 1921, and that in an experimental way, was the Bully Hill group, at Winthrop, where the Shasta Zinc & Copper Co. did some development work and stoping and constructed a 150-ton reverberatory smelter and zinc oxide plant. At this plant the crude ore is crushed to 10-mesh and the sulphur content is reduced by roasting to make it suitable for reverberatory smelting. The copper, gold, and silver are recovered in the matte, and this matte is shipped to the Tacoma smelter. The fume from the reverberatory passes to a bag house, where the zinc oxide is recovered. The oil-flotation plant at the mine was not used in 1921. There was about half a year of construction work and a trial run during the summer. The plant was closed September 1 for additions, and resumption of operations was planned for July, 1922.

The only placers of any importance in Shasta County are those worked by the 4 dredges. The Shasta Dredge Co. operates on the Middle Fork of Cottonwood Creek, near Gas Point. The American Gold Dredging Co., near Redding, resumed operations the middle of December, after a long shutdown. The two Clear Creek dredges, of L. Gardella, worked the entire year about 7 miles southwest of Redding. Several small sluicing mines were productive in a small way at Bayles, Gas Point, Redding, Schilling, and Taylor.

SIERRA COUNTY.

The 30 productive mines of Sierra County made returns in 1921 of $612,267 in gold and $5,236 in silver—a total of $617,503, or $170,642 more than in 1920, the gold increasing $169,373 and the silver $1,269. Of the gold the deep mines produced $591,293 and the placers $20,974. Of the silver the deep mines produced $5,131 and the placers $105. All the ore treated, amounting to 28,768 tons, was siliceous and was handled exclusively by gold and silver mills, and all the gold and silver was recovered as bullion except $310 in gold and $3 in silver from

1 ton of concentrates worked. Of the placers, 4 hydraulic mines produced $14,520 in gold, 2 drift mines $3,103, and 9 sluicing or surface mines $3,351.

The Tightner mine, of the Alleghany Mining Co., at Alleghany, next to the largest producer in the county, was operated throughout the year, and its ore was crushed in the 20-stamp mill of the company. The El Dorado-Wisconsin Mining & Milling Co., owning the Gold Bullion, Nevada, and El Dorado Extension mines, at Alleghany, worked the mining property all of 1921, but the mill was run only for five months. This mill is operated by water power, usually available for eight months. The amalgamation and concentration mill has 10 stamps. The property is opened by an inclined shaft of 173 feet, 589 feet of drifts, and a 1,600-foot adit. The Irelan mine, at the same place, was worked by the Durston Gold Mining Co. The Ophir was operated by the Mariposa Mines Association; the vertical shaft was sunk 200 feet, and the inclined shaft 400 feet. There is a 5-stamp amalgamating mill on the property. The Alleghany Morning Glory was worked from January to September with a small crew. On this property also there is a 5-stamp amalgamating mill. The Original Sixteen-to-One mine, the most productive in the county, was operated the entire year. At this mine the 10-stamp mill is used for crushing and amalgamating the ore, but the concentrates are not treated. Considerable gold came from small mines at and near Alleghany. At the Downieville Gold Mining Co.'s property, at Downieville, 800 feet was drifted on the ledge in 1921, but the 5-stamp mill was run only during April. Other mines at Downieville are the Oro Quartz, White Bear, Ironsides, Willoughby, and several smaller ones. The Kate Hardy, at Forest, and the Primrose, at Sierra City, made some production. At the Four Hills mine it is found profitable only to extract high-grade ore, owing to high costs. The 20-stamp mill is worked only when water is available for air compression.

Of the 15 placer mines in the county none are large producers. The Scales, Council Hill, and Cleveland, between Canyon and Rock creeks, near Scales, were worked by hydraulicking for a little over four months. The Table Rock Mining Co., at Table Rock, owns the Howland Flat, Miners Home, Table Rock, and Winkeye claims, where some hydraulicking was done. The Depot Hill, near Camptonville, is also an important hydraulic mine. Drifting was carried on for six months at the West Point and Wahoo mines, on the slope of Big Canyon, near La Porte.

SISKIYOU COUNTY.

The mines reporting production from Siskiyou County in 1921 numbered 55, a larger number than in any other county in the State and 13 more than in 1920. The total value of the output of the county was $42,929, or $78,938 less than in 1920. The gold yield in 1921 was $42,635, and the silver $294. The decrease in gold was $38,072.

Of the gold output the 18 deep mines produced $6,401 and the 37 placers $36,234. Of the placer gold, $33,755 came from 27 hydraulic mines, $2,479 from 10 small sluicing or surface mines.

Of the silver output the deep mines produced $64 and the placers $230. No copper was produced in the county in 1921. The 654

tons of ore treated yielded $5,781 in gold and $61 in silver; and the 200 tons of old tailings yielded $620 in gold and $3 in silver.

A 2-ton arrastre handled all the ore produced from the Firebug & Neversweat mine, at Black Bear, and some gold was obtained from ore on the dumps of the old Black Bear mine, at the same place. The Cory & Johnson claim, at Callahan, was worked for five months, the 2-stamp mill being used part of the time. At the Chapman the summer was spent in development work and work began on building a 5-stamp mill and flotation plant. At Forks of Salmon a small output was made by both Bonanza and Gilta mines. The Mohegan, at Fort Jones, was worked for six months under lease; and a small quantity of gold came from a sample run of the Hawkeye, at the same place. Development work was done on the Rising Hope, at Hilt, but the mill was run only for sampling. A little gold was taken out of the Leroy Fraction pocket mine, at Hornbrook, and some also came from the Scott Bar pocket mine, at Scott Bar. In the neighborhood of Yreka the few producers were the Cherry Hill, Easter or Oregon, and Mount Vernon.

The producing placers in the county were the Black Bear hydraulic, at Black Bear Creek; small placers at Callahan; Banner and Jefferson Consolidated hydraulic, at Cecilville; Nugget Bar and other small mines at Forks of Salmon and Etna Mills; small hydraulic and sluicing mines at Fort Jones; Sulphur Springs hydraulic on Empire Creek, at Gottville; Jahde hydraulic on Klamath River at Hamburg; Davis Consolidated Mines hydraulic, Huey Hill hydraulic, and smaller ones at Happy Camp and Hornbrook; Robinson hydraulic at Oak Bar; Burns, Casey, Gold Bank, Lanky Bob, Paddy Cronin, and other hydraulic mines at Sawyers Bar; Quartz Hill hydraulic, at Scott Bar; Portuguese Bar drift, at Seiad Valley; Blue Nose and Lange Bros. hydraulic, at Walker; Big Joe Wetzel and other hydraulic and sluicing mines in the vicinity of Yreka. The water season for hydraulic and other gravel mines in this county lasted generally from three to four months.

TRINITY COUNTY.

The 31 placers and 6 deep mines of Trinity County in 1921 produced $439,383 in gold and silver, which was $105,473 less than in 1920. Most of this decrease ($103,394) was in gold. The deep mines produced $9,488 of the gold and the placers $428,505. The output of placers came from 20 hydraulic mines, $76,432; 3 dredges, $350,587; and 8 surface placers, $1,486. Of the silver output the deep mines produced $75 and the placers $1,315. The ore treated, 228 tons, was all siliceous.

The Lost Horse mine is on Scorpion Creek, in the Coffee district, near Carrville, and the Packer is near Coffee. The Brown Bear is an old mine and formerly a large producer, at Deadwood. The Globe, at Dedrick, was abandoned in January, 1921, after some clean-up material was treated. The Gold Hill (Wood Rat), at Lewiston, made a small output, as did the Emma, of the Five Pine Mines, in the Trinity Center district, where a 5-stamp mill was installed.

Of the placer mines in the county the Pacific Gold Dredge Co. dredged on Trinity River near Carrville for 12 months; the Valdor Dredging Co., at Junction City for the same length of time; and the

Trinity Dredge Co., at Lewiston. These are the largest placer producers of the county. Among others are the Snow Gulch hydraulic and smaller mines at Carrville; Underground Treasure (ground sluicing), at Coffee; McAttee Bar, on New River, opposite Quimby Creek, Denny post office; Little Klondike group hydraulic, on South Fork of Trinity River, near Forest Glen; a few small hydraulic mines at Hawkins Bar; Eagle and Rattlesnake, at Helena; Red Hill and a few others at Junction City; Bablew, Horseshoe-Kincaid, Potillo & Brown, Irish & German, and a number of hydraulic and sluicing mines at Lewiston or Weaverville.

TUOLUMNE COUNTY.

In Tuolumne County 26 deep mines produced 24,769 tons of ore, which yielded $89,846 in gold and $2,454 in silver, a total of $92,300, or $168,276 less than in 1920. The placer gold produced was $6,180 and the silver $51, a total of $6,231. The total gold and silver output of the county was $98,531, which was $162,045 less than in 1920.

Of the ore produced 22,695 tons were treated at gold and silver mills and yielded as bullion $84,678 in gold and $1,720 in silver. From 75 tons of ore sent to concentrating mills and 12 tons of concentrates from the milling ore $827 in gold and $13 in silver were recovered. One ton of ore shipped to a smelter returned $124 in gold and $3 in silver. There were 1,998 tons of old tailings treated, which yielded $4,217 in gold and $718 in silver.

Tuolumne is one of the Mother Lode counties of California, but most of the older and formerly productive mines have been idle for some time, and in consequence the total gold yield of the county has fallen off materially. The average value per ton of the ore worked has also decreased and is now the lowest in all the Mother Lode counties.

The Eureka, at Big Oak Flat, with a Kendall mill, was worked only for a few months. The Clio mine, owned by the Clio Vindicator Mines (Inc.), at Chinese Camp, was developed the entire year with a small crew, but the output was nominal. The mine is equipped with a 10-stamp amalgamating and concentrating mill. From the Fourth of July some gold was obtained while cleaning out old tunnels and retimbering. The Experimental Gulch, at Columbia, was worked in a small way to the end of June and then closed down. The 3-stamp mill was put into use, but the 5-stamp mill remained idle. The Green Spring, at Jamestown, at the junction of Green Spring Creek and Stanislaus River, obtained some gold from prospect work in the shaft. A little gold was taken from the old Rawhide, also at Jamestown, one of the former large producers of the county. From the Dutch-App and Sweeney claims, owned by the Pacific Coast Gold Miners Corporation, some gold was shipped from cleaning up around the old mill. At the Belmont-Shawmut mine, at Shawmut, now the most productive in the county, the plant was closed from January to September, and operations were then resumed. During the shut-down the shaft was retimbered and general underground repairs effected. The mill was remodeled, and flotation was replaced by Vanner concentration. Shaft sinking was resumed in December. The deepest of the three shafts in this mine is 2,991

feet deep, and there are over 32,000 feet of drifts, 11,440 feet of raises and winzes, 4,400 feet of crosscuts, and an adit of 1,060 feet. On this property there is a 70-stamp concentration mill, to which 10 Frue vanners were added in 1921. There is also a 25-ton plant for treating concentrates by cyanidation. The process consists of gravity concentration by Butchart tables and Frue vanners, and the concentrates are reground and cyanided. None of the numerous small and pocket mines at and near Sonora were producers of any note in 1921. Some gold was taken out of the Black Oak, at Soulsbyville. The Grizzly Mining Co., at Tuolumne, on the so-called East Belt, deepened the main shaft to 1,850 feet and did about 1,000 feet of drifting. The mine was operated the entire year, but the mill only a short period on test runs. The property is equipped with 20 stamps, 2 Hardinge pebble mills, and a 100-ton cyanide plant with Pachuca agitators. The Patterson Mining Co., at Tuttletown, operated its mine all the year, but the mill was run only 16 days. The 20-stamp mill, with concentrators, was built in 1921 and was not started up until December.

Of the placers in the county the Six-Bit drift mine is at the mouth of Six Bit Creek, near Chinese Camp; the Rough and Ready drift is at Table Mountain, where nine months was spent in driving a bedrock tunnel to tap the buried channel; the Western King is also driving a bedrock tunnel under Table Mountain; the few other placers are small sluicing mines.

YUBA COUNTY.

As in 1920, Yuba County was again the leading county in California in its production of gold in 1921, because of the extensive dredging operations along Yuba River, where 10 of the largest dredges were working the entire year.

The total output of the county was $4,764,383 ($4,738,248 in gold and $26,135 in silver), an increase of $1,280,112 over 1920. The increase in gold alone was $1,270,479, which is far beyond that of any other county in the State. All the 22 mines reporting production from Yuba County were placers of various kinds, with the exception of one small, deep mine at Dobbins, having a nominal yield. The 10 dredges produced $4,722,564 in gold, the 6 drift mines $12,460, and the 5 sluicing or surface mines $2,997. A nominal quantity of gold came from the Landers Bar mine, below the mouth of Deer Creek, in the bed of Yuba River, and some from the Nevada placer claim, near Camptonville, where development work has been going on for three years and must be continued another year before the owners can operate properly in the channel. Considerable gold was produced from the Snowden Hill at Camptonville. At the Pepper, in the Oregon Hill district, bench and ancient river bed gravel was worked and prospecting done most of the year. The Yuba Consolidated Gold Fields, the most productive mining company of any kind in the State, operated 8 dredges continuously to October 15, and 7 dredges the rest of the year in Yuba River adjacent to Hammonton. Considerable platinum and osmiridium were obtained with the gold from this property. The Pacific Gold Dredging Co. worked 1 dredge the entire year in Yuba River near Browns Valley. At the Schoolboy drift mine, at Smartsville, operations consisted

mostly of development work and prospecting, but some gold was produced The Marysville Dredging Co. worked a dredge the full year in the old gravel plain deposited by Yuba River 10 miles northeast of Marysville. Smaller operations were carried on at Camptonville, Dobbins, Smartsville, and Wheatland, all producing more or less gold by either drift or sluicing systems.

OTHER COUNTIES.

Del Norte, Lassen, and Mendocino.—Only small sluicing placer mines reported production from Del Norte County. In Lassen County the Bear mine, at Doyle, installed a 15-ton ball mill in September, but only a few tons of high-grade ore were milled. The Juniper, at Bieber, was worked most of the year, and the 10-stamp mill run part of the time. The total output of Lassen County was very much larger than for some years past—$39,943 in gold and $1,234 in silver. One sluicing placer mine, at Willits, was the only producer in Mendocino County.

Fresno.—Three deep and two placer mines reported production from Fresno County in 1921. The Fortune, at Friant, was operated in a small way and used a ball mill for crushing its ore. The Gilroy, at Grabner, has a 1-stamp mill. The Sunnyside, at Delpiedra, in the Hughes Creek district, was worked only part of a month. It is equipped with a 2-stamp amalgamation mill and Overstrom concentrator. The Giant Rock & Gravel Co. and a few small mines near Friant were the only placer producers. The total yield of the county in gold and silver in 1921 was $13,160.

Humboldt.—The total output of Humboldt County in 1921 was $2,054 in gold and $37 in silver, all from beach-sand sluicing mines at Eureka; the California Mines Syndicate, Elkhorn, Orcutt, and a few other hydraulic claims, at Orleans; ocean-beach placers at Orick; and the Cavanaugh sluicing placer at Weitchpec.

Imperial, Los Angeles, Orange, and San Diego.—The only production from Imperial County came from a few small placers at Potholes. In Los Angeles County the Big Chief quartz mine produced some gold and silver. In Orange County the Silverado, of the Blue Lights Silver Mines, which ships from Villa Park, produced considerable silver and a little gold and lead. In San Diego County a few thousand dollars in gold was obtained in the reopening of some small quartz mines in the Julian district.

Merced and Stanislaus.—In Merced County some gold was produced from the Emerson mine at Livingston and from small sluicing mines near Snelling. In Stanislaus County the Yankee Hill Dredging Co. operated for only a short time about 3 miles from Knights Ferry, on Stanislaus River, and then closed down permanently. The La Grange Gold Dredging Co. operated for one month only, when the dredge sunk and was put out of business. A few small placers were worked productively near La Grange, Knights Ferry, and Oakdale. The total output of Stanislaus County in 1921 was $18,575, of which $18,439 was in gold and $136 in silver.

GOLD, SILVER, AND COPPER IN OREGON.

(MINES REPORT.)

By Charles G. Yale.[1]

INTRODUCTION.

The value of the total mine production of gold, silver, and copper in Oregon in 1921 was about one-third less than in 1920. There was a material decrease in the output of the deep gold mines and a small increase in that of the placers, but the main reason for loss in total output was the almost entire cessation of copper mining, the output of which has fallen in value from nearly half a million dollars to merely a nominal sum. Two new properties of importance have been developed recently, both deep mines, but their production is still small, and a good many of the older properties have remained idle or curtailed operations.

Of the 107 mines that reported production in 1921, 23 were deep mines (22 gold and 1 copper) and 84 were placers (53 hydraulic, 27 surface placers, and 4 dredges).

The southwestern counties in Oregon, which contain an extension of the California gold belt, are Benton, Coos, Curry, Douglas, Jackson, Josephine, and Lane. These counties (except Benton, which reported no production) had a combined output of $163,875 gold and $950 silver, a total of $164,825. The production of placer gold in this region in 1921 was $75,763, an increase of $22,767, and the production of gold from deep mines was $88,112, an increase of $83,858. Four mines were productive in 1921 in Coos County, 7 in Curry, 10 in Douglas, 14 in Jackson, 26 in Josephine, and 2 in Lane.

Northeastern Oregon comprises the counties of Baker, Crook, Grant, Harney, Malheur, Umatilla, Wallowa, and Wheeler. Crook, Harney, Umatilla, and Wallowa counties made no output in 1921. The combined yield of gold in the other four counties was $718,159, of which Baker produced $605,465. This was a decrease of $242,081 for the four counties. The lode mines produced $315,189 in gold and the placers $402,970. The total silver was $41,170. In this region there were 22 productive mines in Baker County, 12 in Grant, 7 in Malheur, and 3 in Wheeler.

[1] In the preparation of this chapter the writer has had the assistance of J. M. Hill and Helen M. Gaylord, both of the United States Geological Survey.

PRODUCTION.

Gold, silver, copper, and lead produced in Oregon, 1911–1921.

Year.	Number of mines producing.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine oz.*	*Pounds.*	*Pounds.*	
1911	176	98,558	$633,407	45,221	93,136	.....	$669,016
1912	210	90,945	770,041	57,081	260,429	39,317	849,886
1913	173	155,901	1,627,710	179,036	43,330	87,207	1,746,402
1914	105	124,331	1,591,461	142,552	39,248	16,436	1,676,153
1915	95	155,791	1,861,796	117,947	451,172	62,957	2,003,509
1916	108	159,071	1,902,179	231,342	3,581,886	28,000	2,937,478
1917	76	142,438	1,491,798	125,656	2,474,487	.....	2,270,874
1918	120	126,681	1,270,465	107,323	2,451,016	10,601	1,983,942
1919	78	96,173	977,845	111,121	2,214,815	.....	1,514,255
1920	67	82,156	1,017,490	82,743	2,355,276	.....	1,541,051
1921	107	40,333	882,034	42,120	174,300	.....	946,639

The ore treated or sold averaged $10.94 a ton in gold and silver, as compared with $7.93 in 1920. The average value of all ore per ton in all metals was $11.50 in 1921, as compared with $13.20 in 1920.

GOLD.

The largest yield of gold from one county was $605,465, and came as usual from Baker County.

The total output of gold from deep mines was valued at $403,301, a decrease of $163,072. The yield of placer gold was $478,733, an increase of $27,616. By far the larger proportion of this placer gold ($381,960) was derived from dredging operations, and an increase from this source is apparent. The dredges produced about 80 per cent of the placer gold and 43 per cent of the total gold of the State. All the gold from the placers was recovered by amalgamation, and of the gold derived from deep mines $95,354 was recovered by amalgamation, $8,537 by cyanidation, and $299,410 by smelting.

Mine production of gold in Oregon in 1921, in fine ounces.

County.	Placers.	Deep mines.		Grand total.
		Siliceous ore.	Copper ore.	
Baker	14,541.18	14,314.16	434.02	29,289.36
Coos	35.46	.....	.....	35.46
Curry	26.90	13.98	.....	40.88
Douglas	148.95	.....	.....	148.95
Grant	4,771.52	463.09	.....	5,234.61
Jackson	1,151.95	410.99	.....	1,562.94
Josephine	2,301.78	3,789.51	.....	6,091.29
Lane	.....	47.94	.....	47.94
Malheur	128.97	35.99	.....	164.96
Wheeler	52.00	.....	.....	52.00
	23,158.71	19,075.66	434.02	42,668.39

Value of placer gold produced in Oregon in 1921.

County.	Hydraulic mines.	Dredging.	Surface placers.	Total.
Baker	$10,912	[a]$381,960	$1,736	[a] $394,608
Coos			733	733
Curry			556	556
Douglas	2,211		868	3,079
Grant	4,621	(a)		[a] 4,621
Jackson	23,317		496	23,813
Josephine	44,026		3,556	47,582
Malheur	2,150		516	2,666
Wheeler	1,075			1,075
	88,312	381,960	8,461	478,733

[a] Production by dredging in Grant County included in figures for Baker County.

SILVER.

The reduction of about 50 per cent in the value of silver produced in Oregon in 1921 was due largely to the nonoperation of copper mines, but some loss is also shown from the siliceous ores. The silver recovered in 1921 by amalgamation was 426 ounces, by cyanidation 1,411 ounces, and by smelting 35,992 ounces, which includes the recovery from ore and from flotation concentrates.

Mine production of silver in Oregon in 1921, in fine ounces.

County.	Placers.	Deep mines.		Grand total.
		Siliceous ore.	Copper ore.	
Baker	3,235	34,935	1,339	39,509
Coos	15			15
Curry	9	9		18
Douglas	29			29
Grant	525	1,088		1,613
Jackson	143	43		186
Josephine	301	169		470
Lane		232		232
Malheur	26	14		40
Wheeler	8			8
	4,291	36,490	1,339	42,120

COPPER.

Only 2,398 tons of copper ore, containing 174,300 pounds of copper and carrying some gold and silver, was produced in Oregon in 1921.

MINING INDUSTRY.

Gold and silver produced in Oregon in 1921, by methods of treatment.

County.	Ore to gold and silver mills.			Ore to concentrating mills (short tons).
	Short tons.	Gold.	Silver (fine ounces).	
Baker	2,248	$14,102	1,310	36,298
Grant	100	2,400	77	.....
Jackson	451	8,496	43	.....
Josephine	346	78,220	168	.....
Lane	40	991	232	.....
Malheur	15	558	10	.....
	3,200	104,767	1,840	36,298
Average value per ton	.....	32.74	$0.575	.....

County.	Concentrates produced.			Crude ore to smelter.		
	Short tons.	Gold.	Silver (fine ounces).	Short tons.	Gold.	Silver (fine ounces).
Baker	2,554	$283,431	33,237	23	$7,339	1,727
Curry	.....	.....	.....	2	289	9
Grant	.....	.....	.....	800	7,173	1,011
Josephine	1	116	1	.....	.....	.....
Malheur	.....	.....	.....	10	186	4
	2,555	283,547	33,238	835	14,987	2,751
Average value per ton	.....	110.98	$13.01	.....	17.95	$3.29

Mine production of gold, silver, and copper in Oregon in 1921.

County.	Ore (short tons).	Quartz gold.		Placer gold.		Total gold.	
		Fine ounces.	Value.	Fine ounces.	Value.	Fine ounces.	Value.
Baker	38,569	14,748.18	$304,872	14,541.18	$300,593	29,289.36	$605,465
Coos	.....	.....	.....	35.46	733	35.46	733
Curry	2	13.98	289	26.90	556	40.88	845
Douglas	.....	.....	.....	148.95	3,079	148.95	3,079
Grant	900	463.09	9,573	4,771.52	98,636	5,234.61	108,209
Jackson	451	410.99	8,496	1,151.95	23,813	1,562.94	32,309
Josephine	346	3,789.51	78,336	2,301.78	47,582	6,091.29	125,918
Lane	40	47.94	991	.....	.....	47.94	991
Malheur	25	35.99	744	128.97	2,666	164.96	3,410
Wheeler	.....	.....	.....	52.00	1,075	52.00	1,075
	40,333	19,509.68	403,301	23,158.71	478,733	42,668.39	882,034

County.	Quartz silver.		Placer silver.		Total silver.		Total value.
	Fine ounces.	Value.	Fine ounces.	Value.	Fine ounces.	Value.	
Baker	36,274	$36,274	3,235	$3,235	39,509	$39,509	[a] $667,459
Coos	.....	.....	15	15	15	15	748
Curry	9	9	9	9	18	18	863
Douglas	.....	.....	29	29	29	29	3,108
Grant	1,088	1,088	525	525	1,613	1,613	109,822
Jackson	43	43	143	143	186	186	32,495
Josephine	169	169	301	301	470	470	126,388
Lane	232	232	.....	.....	232	232	1,223
Malheur	14	14	26	26	40	40	3,450
Wheeler	.....	.....	8	8	8	8	1,083
	37,829	37,829	4,291	4,291	42,120	42,120	946,639

[a] Includes value of 174,300 pounds of copper—$22,485.

PRODUCTION BY COUNTIES.

BAKER COUNTY.

The 22 productive mines of Baker County in 1921 yielded metals having a combined value of $667,459. This was more than 70 per cent of the value of the total output of the State in 1921 but $739,600 less than the value of the output of Baker County in 1920. This decrease not only shows that the eastern part of the State suffered most in the general mining depression, but illustrates the great effect of the operation of idleness of even a few large properties, such as were unproductive in this county in 1921. The value of gold from deep mines decreased $245,824 and that of silver decreased $42,838, but the chief decrease was in the value of copper, $410,886, caused by the idleness of the large properties that formerly produced this metal. The placer mines of the county produced $39,091 less gold than in 1920; the surface mines gained somewhat, but the dredges yielded about $16,000 less, and the hydraulic mines about $24,700 less. There were 10 deep mines and 12 placers reporting production in 1921—5 more than in 1920. The siliceous ore mined or treated produced $295,900 in gold and 34,935 ounces of silver, an average recoverable value in gold and silver of $9.17 a ton, as compared with $9.62 a ton in 1920.

The 2,248 tons of siliceous ore treated at gold and silver mills produced $14,102 in gold and 1,310 ounces of silver, an average value of $6.86 a ton, as compared with $8.79 a ton in 1920. From 36,298 tons of ore concentrated were derived 2,554 tons of concentrates, which yielded $283,431 in gold and 33,237 ounces of silver, a recovery of $8.72 per ton of ore and about $124 per ton of concentrates. The 23 tons of ore shipped to smelters produced $7,339 in gold and 1,727 ounces of silver.

Baker district.—In the Baker district proper there was a production of $106,708 in gold and $13,445 in silver from various deep mines and of $7,896 in gold and $24 in silver from a number of hydraulic mines. Much of this gold and silver was doubtless brought to the banks, gold buyers, and purchasers of ore, bullion, and concentrates in Baker City from other parts of Baker County and adjoining counties. The larger proportion of the gold and silver from deep mines was obtained from ore bought by the local agents of a company whose plant for the reduction of ores, concentrates, etc., is in another State.

Bridgeport district.—Only one placer mining company reported production from the Bridgeport district, and no deep mines made any output. The Oregon Dredging Co. reported that it did not operate in 1921.

Conner Creek district.—From the Conner Creek district only one deep mine reported a small production.

Cornucopia district.—The largest producer in the Cornucopia district is the Cornucopia Mines Co., which operated the Union and Last Chance mines. Development work on the Union mine continued throughout the year, but that on the Last Chance for only nine months. These properties are developed by cross-cut tunnels driven 4,500 and 3,700 feet, respectively. The mines are equipped with one 100-ton 20-stamp cyanide plant and one 80-ton 20-stamp cyanide plant, but the mills were run only the first two months of 1921.

Cracker Creek district.—The most productive deep mines in Oregon are at Bourne, in the Cracker Creek district. These were operated the first half of the year by the Eureka & Excelsior Gold Mines Co. and the last half of the year by the Blue Mountain Mines Co. The mines are opened through a 3,000-foot adit, but a great deal of work has recently been done, and the total developments now amount to 12,000 feet. The equipment consists of a 200-ton flotation plant, the concentrates being shipped to the smelter at Tacoma for treatment. Since June, when the Blue Mountain Co. took charge, the mill has been completely reconstructed.

Dixie district.—The Dixie mine, in the Dixie district, is developed by two tunnels, an upper one of 400 feet, now abandoned, and the lower or present level, of 800 feet, with drifts aggregating a few hundred feet. The property includes a 5-stamp amalgamation mill run by steam power.

Eagle Creek district.—In the Eagle Creek district the Sanger group, formerly owned by the Sanger Gold Mines Co. but now by the Baker Valley Land Co., was worked under lease in 1921. There is a 10-stamp amalgamation mill on the property.

Greenhorn district.—The quartz mine of the Bonanza Consolidated Gold Mining Co. in the Greenhorn district was operated a short time in 1921. The 5-stamp mill was moved from the old mill site to the mouth of the new tunnel during the year but was run for only 15 days in December. A few small mines in this district were also productive.

Homestead district.—A few small gravel mines were operated along Snake River in the Homestead district in 1921.

Irondyke district.—The Homestead-Iron Dyke Mines Co., formerly the largest producer of copper in the State, operated for only 21 days in 1921, and its long idleness accounts to a very large extent for the great falling off in value of the total metal production in Oregon for the year. The concentrates were shipped to the International Smelting Co., Salt Lake City, Utah. The property is equipped with a 100-ton concentrating mill, ball mill, and flotation plant.

Pine Creek district.—The productive hydraulic mines in the Pine Creek district were the Bull Dog, Burnt River, Cow Creek, Patterson, and Yellow Metal. Pine Creek is about a mile from Hereford, on Burnt River. The output of this district was $2,062. At the Yellow Metal mine a new reservoir and ditch have been provided, which are ample to ascertain the exact condition and value of the auriferous gravel.

Sumpter district.—In the Sumpter district is the most productive gold-dredging field in the State, and both the Powder River Gold Dredge Co. and the Sumpter Gold Dredge Co. were large producers in 1921. The Powder River Co. operated the entire year but the Sumpter Co. for only nine months.

Virtue district.—Ore was mined by lessees from the Sanger mine of the Virtue group and milled by the Virtue Mines Development Co. This mine is developed through an 800-foot vertical shaft. It is equipped with a 20-stamp amalgamation and concentration mill and a 50-ton cyanide plant.

Mines under development.—The names of numerous more or less prominent mines do not appear among those enumerated above, for the reason that no production was reported from them in 1921. It

should not be inferred, however, that such mines are permanently closed or remained entirely idle during the year. Under the prevailing adverse conditions some could make no profit and others would have suffered a loss if they had mined or treated ore. For this reason many of them did merely assessment work or development work for all or part of the year, and some account of these active but unproductive properties is given to set forth more fully the prevailing condition in the mining industry in Oregon.

At the properties of the National Mines Co., at Haines, in the Rock district, where there is a 150-ton concentration flotation mill, considerable development work was done, but the reduction plant was not used. On the Gold Reef mine, at Cornucopia, work was resumed in June. The tunnel was extended 1,000 feet toward the Red Cross vein up to January, 1922, and is still being extended. The company has a 60-ton concentration and cyanide plant. The Weatherby-Bonanza mine, at Dixie, was developed for several months by retimbering the old tunnel and catching up old workings. The 5-stamp mill was not run. The Cincinnati-Reagan mine, at Durkee, was more or less developed during most of the year, but the ore was placed on the dump and the stamps and concentrators remained idle. The Salter and Mayflower mines of the Heppner Mining Co., at Greenhorn, were developed during six months of the year, but the small mill was not used. Some development work was done on the Rand and McCarthy mines, at Homestead, but no ore was treated. At the Bay Horse, Huntington, developing and blocking out ore continued, and a complete camp with railroad siding was constructed. Development work was done for five months on the Bushwhacker and Echo mines, at Medical Springs, in the Sanger district, but no ore was shipped. The Imperial Eagle Co., at Sumpter, in the Cable Cove district, retimbered workings and blocked out ore from August until the end of the year. The reopening of Eagle No. 3 tunnel was the most important work undertaken, but it is still incomplete. The 100-ton concentration and amalgamation plant received a general overhauling.

COOS AND CURRY COUNTIES.

In Coos County ocean-beach black-sand placers at Bandon and Bullards were worked productively. The Big Joe hydraulic mine, on Johnson Creek at Myrtle Point, and other small mines at Powers, in the Sixes district, made a small output of gold. The total output of the county was valued at $748. In Curry County black-sand beach mines at or near Gold Beach, Port Orford, Sixes River, and Wedderburn were worked productively. The Lucky Boy quartz mine at Marial, in the Mule Creek district, also produced a small quantity of ore. The total output of the county in gold and silver was $863 from 1 deep mine and 6 placer mines.

DOUGLAS COUNTY.

In Douglas County 7 hydraulic and 3 surface placer mines produced $3,108 in gold and silver. The hydraulic mines were worked from 40 days to 4 months, according to the available water supply. The principal mines were the Boulder and Starvout Nugget, at

Azalea; Picune, at Canyonville; Burrows, at Days Creek; Douglas, at Glendale; and Victory, at Kohler, all in the Green Mountain district. Small mines at Perdue, Riddles, and Roseburg also produced. The total output of the county was $3,079 in gold and $29 in silver.

GRANT COUNTY.

Of the 12 productive mines in Grant County in 1921, 2 were deep mines, 9 hydraulic mines, and 1 dredge. The deep-mine output was $9,573 in gold and $1,088 in silver, and the placer output was $98,636 in gold and $525 in silver. The Beaver Gold Mining Co. was a lessee on the Buffalo-Monitor mine, at Granite, where work was carried on for nine months. The other deep mine was the Mother Lode, at Canyon City. The principal hydraulic mines were the Quartz Gold, at Canyon City, and the Ray, at Prairie City, both in the Canyon district; the Big Nugget, Lightning Creek, and Onion Creek, in the Granite district; and the Gumbo and Interstate, at Susanville, in the Susanville district. The Empire Dredge Co. operated at John Day, in the Canyon district. The Ben Harrison mine, at Whitney, formerly a large producer, with a 125-ton flotation plant (ball-mill crushers), was closed in October, 1920, but considerable development work was done from May 1 to October 31, 1921, though there was no production, and the reduction plant was idle. The Continental Mining Co., in the Granite district, sunk a 100-foot shaft from the tunnel on its mine and ran several drifts during the year, but the 20-ton flotation plant was not used. La Bellevue, at Granite, is one of the oldest mines of Grant County, but has not been worked for some years. During 1921, however, development work was resumed and the installation of a reduction plant begun. On the Magnolia mine, at Granite, the company put heavier rails in the main tunnel and did considerable development work, but no ore was treated. On the Lucky Bill and Ophir group, at Prairie City, the Utah-Oregon Gold Mines Co did $2,000 worth of development work but shipped no ore.

JACKSON COUNTY.

There were 14 productive mines in Jackson County in 1921, of which 3 were deep, 9 hydraulic, and 2 surface sluice properties. The combined output was $32,309 in gold and $186 in silver. The principal deep mine is owned by the Gold Ridge Mining & Milling Association, of Medford, and is at Gold Hill, in the Gold Hill district. A 5-stamp mill was installed on the property during the year and was operated intermittently. The Hazel mine, at Rogue River, in the Foots Creek district, and the North Pole mine, of the Robinson Mining Co., in the Cracker Creek district, each made a small production. The principal hydraulic mines are the Pacific Placer Co. (old Layton), at Applegate; Houston and Centennial, in the Willow Creek district; Cook and Ancient River, at Rogue River, in the Foots Creek district; and Sterling and Ulrich, at Jacksonville. The surface placers were the Benson, at Ruch, in the Star Gulch district, and small mines in the Jacksonville district.

The following mines were under development in 1921 but were unproductive. At the Afterthought mine, at Applegate, from June to November, work was carried on in driving a crosscut tunnel. A 5-stamp mill is to be erected. The Millionaire Mining Co., of Central

Point, has a mine at Gold Hill which was opened in August, 1920, and has now an electric power line and all modern equipment for operation. The plant consists of two Nissen stamps, with appliances for amalgamation and concentration. During 1921 the company sank two shafts, one 162 feet deep and the other 80 feet, and opened 500 feet of drifts. The Opp mine, at Jacksonville, has been idle for the last five years, but is being reopened and will be in full operation shortly. At the Buzzard mine of the Pearl Mining Co., at Trail, drifting and a thorough sampling of the ore body were carried on.

JOSEPHINE COUNTY.

The total output of gold and silver in Josephine County in 1921 was valued at $126,388, which was $82,541 more than in 1920. There were 15 productive mines in 1920 and 26 in 1921. Of these 3 were deep mines, 16 hydraulic, and 7 sluice. The deep mines produced $78,336 in gold and $169 in silver and the placers $47,582 in gold and $301 in silver. Of the deep mines the January First, in the Sucker Creek district, was worked for three months only. It has a 3-stamp amalgamation and concentration mill. The Victor, at Merlin, in the Galice district, made a small output. The Boswell, at Holland, in the Sucker Creek district, is now considered one of the promising mines of the State. Although located in 1914, it was not until January, 1921, that the Boswell Mining Co. obtained the property and installed a crusher, a Huntington mill, and a small cyanide plant, and built an 800-foot tramway between the mine and the mill. The workings are shallow, and the rich ore produced has all been taken out near the surface, but further development work is in progress. The hydraulic mines in the county mainly had short runs, for there was a scarcity of water in the season. The principal hydraulic mines are the Kentta, Laymond, McCourt, and Parker & Goldsby, at Holland, in the Althouse district; the Anderson and Gold Leaf, at Kerby, in the Waldo district; the Dean and Old Channel, at Merlin, in the Grants Pass district; the Oscar Creek, at Murphy; the Columbia Mines Co. and Red Point, at Placer, in the Greenback district; the Johnson & Ramsey and Siskiyou, at Takilma, in the Althouse district; the Logan group and Deep Gravel, at Waldo; and the Blue Channel, at Wolf Creek, in the Greenback district.

Several mines in Josephine County reported no production in 1921 but carried on development work. Of these the following may be mentioned: The Hammersley or Daisy mine, at Placer, in the Jump-Off-Joe district, had the old workings cleaned and retimbered, and drifting is being done to strike the ledge under the old workings. The mine of the Oregon Gold Mines Co., at Holland, is supposed to be the first quartz mine located in Oregon. A new tunnel, 780 feet long, has been run and also a raise of 188 feet to the old workings. Altogether $21,000 is reported to have been spent in the last two years in reopening this property. At the California mine, at Leland, in the Mount Reuben district, a wagon road 3½ miles long was built to a point on Reuben Creek, from which a tunnel is being run that crosscuts the formation of Mount Reuben. The level of this tunnel will be 2,000 feet below the lower workings of the California mine. Its length will be about 5,700 feet, of which 250 feet has been cut. At the Almeda mine, Almeda, a crew of 12 men was employed in

retimbering and development work. At the Myrtle mine, at Selma, in the Illinois River district, a plant consisting of a 12-ton crusher, 6-ton ball mill, plates, gas engine, etc., was installed in 1921, but was run only a few days. Considerable development work was done.

LANE, MALHEUR, MARION, AND WHEELER COUNTIES.

In Lane County only two deep mines reported production, both in the Bohemia district. Malheur County, with a total production of $3,450 in gold and silver, has one productive deep mine and four placers, the Amelia, Glengarry, Golden Eagle, and Colt Bros., all in the Mormon Basin district, besides a few smaller ones. The placer mines in Wheeler County are all at Antone, in the Spanish Gulch district. In this district several hundred tons of ore was taken out of the Golden Age group of quartz mines, but none of it was shipped. Tunneling work was carried on for about six months. There was no output in 1921 from any mine in Marion County, but the Silver King Mining Co., of Albany, in the Elkhorn district, has prospected its mine for 400 feet by shafts and tunnels and started the erection of a power plant, which has been completed in 1922. This plant develops about 200 horsepower by a Pelton wheel, which will furnish power to operate both mine and mill.

COBALT.

By Frank L. Hess.

The only cobalt ore known to have been produced in the United States in 1921 was a carload of heterogenite that was mined by Harvey Hardy and associates from deposits near Good Springs, Nev., and was about ready to be shipped at the end of the year. Heterogenite is an unusual mineral and as found at Good Springs occurs in irregular black masses filling cracks or replacing the carbonates in impure limestone and in less quantity in mammillary masses. The deposits so far found are not very large. The ore was thought to carry about 8 per cent of cobalt and was to be shipped to the Shepherd Chemical Co., Cincinnati, Ohio, to be manufactured into driers for paint. The ores mined at Good Springs are very desirable for that purpose, as they are comparatively free from sulphur, arsenic, antimony, iron, and other impurities.

The deposits of cobaltite and related minerals at Blackbird, Idaho, have so far not proved profitable, but more or less work is being done on them, and as the Haynes Stellite Co. (now controlled by the Union Carbide Co. of Niagara Falls, N. Y.) has applied to the Federal Power Commission for permission to construct a dam on Big Creek, 3 or 4 miles away, a conduit 1,200 feet long, and a power house to develop 270 electric horsepower, further work will probably be done on the mines. Prices for cobalt rose so high that the company bought a mine at Cobalt, Ontario, from which it has been obtaining sufficient ore to furnish the metal required. The Missouri Cobalt Co. did not operate during the year. In 1920 the company produced, operating only part of the year, 102,410 pounds of cobalt oxide and cobalt hydrate, valued at $262,801.

The price of cobalt during the earlier part of 1921 was high, beginning, according to quotations in the Engineering and Mining Journal, at $6 a pound for metal, $4.10 for black oxide, and $1.60 for sulphate. With a division of control of the productive properties the prices gradually fell to $3 a pound for metal and $2.35 for black oxide. In the second half of October the price of black oxide fell to $2 to $2.10 a pound; sulphate was not quoted.

As there was no cobalt produced in this country that reached the market during the year, practically all the cobalt used, either as metal or in compounds, was imported. A little may have been in stock from previous domestic production.

IMPORTS.

Cobalt ore, cobalt, zaffer, and oxide imported for consumption in the United States, 1919–1921.[a]

Year.	Ore.		Cobalt.		Zaffer.		Oxide.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1919	17,045	$2,832	60,511	$141,450	.....	.....	131,424	$184,751	208,980	$329,033
1920	13,039	4,794	143,603	326,864	220	$14	202,724	399,605	359,586	731,277
1921	7,657	3,235	38,442	105,539	.....	.....	164,003	342,426	210,102	451,200

[a] Statistics obtained from the records of the Bureau of Foreign and Domestic Commerce.

Prior to January, 1919, cobalt, cobalt ore, and zaffer were not classified separately. Zaffer has practically ceased to be an article of importation, being replaced in the ceramic trade by cobalt oxide.

MOLYBDENUM.

By Frank L. Hess.

No molybdenum ores are known to have been mined in the United States in 1921. In 1920 the Molybdenum Corporation of America produced from its mine near Questa, N. Mex., 1,607 tons of ore, from which were made 84,770 pounds of concentrates carrying 68.62 per cent of MoS_2 (41.17 per cent Mo) that were sold to an allied company, the Electric Reduction Co., of Washington, Pa., for $17,207.[1]

Molybdenum in ore and concentrates produced and sold in the United States, 1916–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1916	206,740	$205,000	1919	297,926	$341,814
1917	350,200	495,350	1920	34,900	17,207
1918	861,637	1,253,700	1921		

There was on hand in this country at the beginning of 1921 probably between 1,000 and 2,000 tons of ferromolybdenum at various points, and the Climax Molybdenum Co. had a considerable stock of concentrates on hand, an ample supply under the condition of the steel industry. However, a number of steel manufacturers, particularly some shovel and automobile makers, added molybdenum to their steels, and the stocks gradually dwindled.

Besides the inroads into stocks on hand, statistics furnished by the Bureau of Foreign and Domestic Commerce show that 29,783 pounds of ore, presumably concentrates, valued at $20,471, was imported into the United States, against 15,639 pounds, valued at $9,707, in 1920. Imports of "molybdenum and ferromolybdenum," probably all ferromolybdenum, in 1921 amounted to 345 pounds, valued at $349.

The use of molybdenum seems to be getting on a sounder footing than ever before, and the manufacturers who use it believe that as a toughener of steel it serves a real purpose when added to carbon steels in quantities reaching 0.35 per cent. It is used in automobile axles and springs and in shovels.

[1] Data published by express permission of the company.

NICKEL.

By Frank L. Hess.

PRODUCTION.

At one time, before the discovery of the great nickel deposits at Sudbury, Ontario, nickel was produced at Gap, Pa., but competition became so strong that the mine was closed in 1893 and has not been reopened. Except for about 164 tons of nickel produced at Fredericktown, Mo., in 1909, no nickel, except as a by-product in electrolytic copper refining, was produced in this country until 1919, when the Missouri Cobalt Co. made some output from the Fredericktown property, and again in 1920. In 1921, however, nickel was isolated in the United States only as a by-product in electrolytic copper refining by three companies, the American Smelting & Refining Co., the Raritan Copper Co., and the Nichols Copper Co.

Nickel content of nickel salts and metallic nickel produced in the United States as a by-product in the electrolytic refining of copper, 1915–1921, and from mixed ores in 1919 and 1920.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1915	822	$538,222	1919	511	$434,485
1916	918	671,192	1920	365	293,250
1917	402	331,556	1921	111	86,000
1918	441	401,000			

The nickel industry, like others, reflected the depressed business conditions of the world. The American output, being a by-product of the copper industry, itself severely hit by the hard times, was much smaller than usual.

The International Nickel Co. was as usual the largest nickel producer in the world, all of its ore coming from Sudbury, Ontario. The ores were roasted and matted at Copper Cliff, Ontario. Refining was carried on both at its new plant at Port Colborne, Ontario, and at Bayonne, N. J. As nickel for the United States is supplied in such large part by this company from its Canadian mines, it seems well to quote from the "Preliminary report of the mineral production of Canada during the calendar year 1921" compiled by A. C. Young and issued by the Dominion Bureau of Statistics.

Of the important metals for which Canada is famous, nickel has probably suffered the severest decline. This is entirely due to the overstocked condition of the world's nickel markets and to the slowness with which the large stocks held by all the warring countries have been absorbed. Owing to its extensive use as a war metal, nickel has moved toward normal even more slowly than the other metals. The total Dominion output in 1921 was 19,293,186 pounds or 31.4 per cent of the production during 1920, which amounted to 61,335,706 pounds. There was little or no selling and the quotation of 35 cents per pound used for calculating the total value given in this report was the average market quotation obtaining in Canada throughout the year. At this rate the value of the Canadian output in Canadian funds would be $6,752,615. Practically all of Canada's nickel has been derived from the Sudbury district. Dur-

ing 1921 the Mond Nickel Co. continued to operate at reduced capacity throughout the whole year, but the British America closed down in March and the International Nickel soon followed. The total output from the Sudbury smelters amounted to 19,497 tons of matte, which contained 12,645,391 pounds of copper and 19,256,900 pounds of nickel, the average contents of metals in the matte being about 32 per cent copper and 49 per cent nickel. The year's output included, as usual, nickel metal produced as such from the smelting of silver-cobalt ores and some nickel contained in oxides and nickel salts. The nickel from these sources amounted to 36,286 pounds, all produced by the South Ontario smelters.

The nickel refineries at Deschenes, in Quebec, and Port Colborne, Ontario, treated 5,558 tons of matte, from which they produced 5,419,174 pounds refined nickel in ingots and shot, 2,926,407 pounds of copper, two-thirds of which was contained in blister, the balance being electrolytically refined in Canada. As usual the Mond output was exported to Wales for refining. A small quantity of matte from the International Nickel Co.'s refinery at Port Colborne was shipped to the United States, from which together with the treatment of accumulated residues there was produced a small quantity of metals of the platinum group. The British America Nickel Corporation also produced some of the platinum-group metals.

The exports of nickel metal, nickel-copper matte, etc., during 1920 and 1921 are shown below:

Canadian exports of nickel, 1920-21.

	1920		1921	
	Pounds.	Value.	Pounds.	Value.
Nickel, fine	8,498,300	$2,982,717	4,794,500	$1,684,454
Nickel contained in matte	51,701,000	9,006,140	8,064,600	1,418,490
	60,199,300	11,988,857	12,859,100	3,102,944

IMPORTS.[1]

Nickel imported for consumption in the United States, 1916–1921.

Year.	Nickel, nickel ore and matte, nickel oxide, and alloys of nickel with copper, etc.		Value of manufactured articles of nickel and nickel sheets and strips.	Total value.
	Pounds.	Value.		
1916	72,649,377	$9,899,340	$25,880	$9,925,220
1917	75,526,767	9,617,163	45,248	9,662,411
1918	73,207,147	11,520,775	115,243	11,636,018
1919	36,562,388	8,334,135	90,451	8,424,586
1920	48,492,076	10,657,193	200,464	10,857,657
1921	4,396,119	1,210,317	107,155	1,317,472

Nickel imported for consumption in the United States, 1920 and 1921, by forms.

Form.	1920		1921	
	Pounds.	Value.	Pounds.	Value.
Nickel ore (nickel content)	1,541,237	$145,723	660,067	$129,053
Nickel matte (nickel content)	40,044,871	8,318,149	1,382,111	303,733
Nickel, alloys, pig, bars, etc	6,905,753	2,193,256	2,324,993	770,021
Nickel oxide	215	65	28,948	7,510
All other manufactures	(a)	200,464	(a)	107,155
	.....	10,857,657	.....	1,317,472

a Quantity not recorded.

[1] Statistics obtained from the records of the Bureau of Foreign and Domestic Commerce.

TANTALUM.

By Frank L. Hess.

Tantalum and its close associate, columbium, are yet among the experimental metals—those which possess attractive properties but which have not yet been shown to have uses that some other and cheaper metal or alloy will not serve as well or better. With the numberless new uses for the elements, their alloys and compounds, that constant experimentation is developing, it seems probable that for these metals also places will be found that they will fill better than any others.

To obtain these metals in a pure state, or a state of purity comparable to that of the iron, aluminum, or copper of ordinary commerce, is very difficult and tedious though not impossible, as with uranium and vanadium. However, like uranium and vanadium, they may be made into ferros with comparative ease. Several patents for their use in steel have been taken out, but the steels have not been made except in experimental lots.

The only output of these metals made in the United States for several years back has been that shipped by Dr. A. T. Roos, Deadwood, S. Dak. In 1921 Dr. Roos shipped 3,400 pounds[1] of columbite guaranteed to contain 70 per cent of the combined tantalum and columbium oxides. The material was valued at about $1,150. The columbite came from pegmatite dikes near Keystone and Hill City, in the southern part of the Black Hills. Previous shipments of Dr. Roos have been as follows: 1920, 4,000 pounds, valued at $1,450; 1919, 300 pounds, valued at $90; 1918, 4,500 pounds, valued at $2,250. All the ore is thought to have been used for experimental purposes, most of it in ferro-tantalum-columbium, without separation of the two metals.

Under the heading "Tantalum" 1,229 pounds of material, valued at $788, was imported in 1921. From the value given it seems probable that this material was tantalum ore.

The records of the Bureau of Foreign and Domestic Commerce show that there was also imported for consumption in 1921 6,785 pounds of "tantalum steel-hardening ores," valued at $1,327.

[1] Figures are published with the express permission of Dr. Roos.

TITANIUM.

By Frank L. Hess.

The deposits of rutile (titanium dioxide, TiO_2) at Roseland, Nelson County, Va., were idle in 1921, so that neither rutile nor ilmenite was produced there, nor, so far as the United States Geological Survey knows, was ilmenite produced at any other point in this country.

Rutile has been found in large quantity in this country only near Roseland. Other deposits are known in Goochland and Hanover counties, Va.; titanium dioxide in its various forms (brookite, octahedrite, and rutile) is found at Magnet Cove, Ark.; and rutile in minute almost ruby-red crystals forms possibly 1 per cent or more of an amphibolite dike near Custer, S. Dak., but of these only the Roseland deposit has proved of commercial value.

Ilmenite-bearing sands at Pablo Beach, Fla., have been worked and the titaniferous magnetites of the Adirondacks have furnished some ore from which ferrotitanium has been made. Other large deposits of titaniferous iron ore are found near Hartville, Wyo., and there are many smaller deposits in the United States. So far the potential supplies of titaniferous iron ore have greatly exceeded the demand, for the ferrotitanium business has never become large, though it seems to be growing.

The manufacture of titanium pigments to replace white lead is one of the possible lines of expansion in the future, and many patents covering processes have been taken out.

Titanium minerals produced in the United States, 1917–1921.

Year.	Rutile concentrates.		Ilmenite concentrates.		Total value.
	Short tons.	Percentage of TiO_2.	Short tons.	Percentage of TiO_2.	
1917	206	93	1,339	53–55	$45,637
1918	261	95	1,644	53–55	57,750
1919[a]	102	94–96	106	48–50	22,520
1920	277	94–96	268	50	(b)
1921	None.	None.	None.	None.	.....

[a] Virginia production only; information regarding Florida not available for publication.
[b] Survey not at liberty to publish figures.

TUNGSTEN.

By Frank L. Hess.

No tungsten ore was produced in the United States during 1921. This is the first year in which no production was made since 1899, or, in other words, since tungsten ore has been a matter of regular commerce in this country. In 1920 an equivalent of 216 tons of concentrate carrying 60 per cent of tungsten trioxide (WO_3) was mined and marketed.

Concentrated tungsten ores (carrying 60 per cent of tungsten trioxide) produced and sold in the United States, 1915–1921, and average price per unit.

Year.	Short tons.	Value.	Average price per unit.	Year.	Short tons.	Value.	Average price per unit.
1915	2,332	$4,100,000	$29.30	1919	327	$353,900	$18.02
1916	5,923	12,074,000	33.98	1920	216	101,800	7.86
1917	6,144	6,783,000	18.40	1921			
1918	5,061	7,049,300	23.24				

Supplies of tungsten ores in the United States, 1916–1921, in short tons.

Year.	Production.	Imports.			Exports.[a]		Apparent consumption plus stocks on hand (accumulated during the year only).[c]
		Ore.	Tungsten and ferrotungsten.	Estimated equivalent in ore carrying 60 per cent of tungsten trioxide.[b]	Tungsten and ferrotungsten.	Estimated equivalent in ore carrying 60 per cent of tungsten trioxide.	
1916	5,923	4,072	43	4,522	287	646	9,799
1917	6,144	4,879	1	5,310	1,162	2,615	8,839
1918	5,061	11,609		12,854	616	1,386	16,529
1919	327	9,408	198	10,915	19	43	11,193
1920	216	1,949	999	4,416	2	5	4,627
1921		1,614	253	2,371			2,371

[a] No record of tungsten ore exported is at hand, although it is known that some has been shipped abroad.

[b] These items include the ore except Chinese (considered as carrying 65 per cent of tungsten trioxide), and the tungsten and ferrotungsten (considered as equivalent to 2¼ times their weight in ore carrying 60 per cent of tungsten trioxide). Chinese ore imported has been considered as 67.5 per cent of tungsten trioxide.

[c] Production plus imports minus estimated equivalent in ore of the exports of tungsten and ferrotungsten. The apparent consumption is at best only an approximation.

The end of the war and the consequent slump in prices, the subsequent depression in business that became most acute in 1921, and the

large imports of the very cheap and rich ore from China caused tungsten prices to drop steadily until they reached the lowest point ever known in this country except for a little surface ore picked up in Boulder County, Colo., before the use of tungsten was established. Some ore carrying more than 65 per cent of tungsten trioxide was sold in New York for $1.60 a unit, and it is possible that a small quantity was sold for even less.

Under these conditions it would have been impossible for American mines to operate, even had the rich outcrops not already been removed.

In spite of the low prices, Chinese tungsten ore was mined and shipped to this country throughout the year, and smaller quantities were shipped from South America. The Chinese ores are mostly obtained from placers in northern Kwangtung and southwestern Kiangsi, and only a comparatively small quantity of ore has been mined from veins. The production from the placers seems already to have exceeded that from the Burmese placers, the next largest, but although the Burmese placers are apparently almost exhausted, the Chinese placers are still shipping very cheap ore in notable quantity. It seems probable that during 1921 about as much Chinese ore was shipped to Germany as to the United States.

The tool-steel trade was very dull during the year, and it seems sure that the consumption of ore was much less than the imports and that the already large stocks of 1920 became somewhat larger, so that at the end of the year there was probably stored in this country in the form of ore and ferrotungsten an equivalent of close to 15,000 tons of ore carrying 60 per cent WO_3. Imports of tungsten ores as shown by the records of the Bureau of Foreign and Domestic Commerce, are given in the following table.

Tungsten-bearing ores imported into the United States, 1920 and 1921, by countries.[a]

[General imports.]

1920			1921		
Country.	Short tons.	Value.	Country.	Short. tons.	Value.
Argentina	86	$64,284	Argentina	57	$11,588
Bolivia	158	85,726	Bolivia	47	13,620
Chile	148	74,906	Chile	166	36,389
China	420	142,572	China	789	106,059
Hongkong	859	276,842	England	189	30,535
Japan	128	98,723	Hongkong	318	72,499
Mexico	91	12,055	Mexico	40	2,639
Panama	13	4,917	Peru	8	3,428
Peru	44	18,765			
France	1	353		1,614	276,757
"British Indies"	1	450			
	1,949	779,593			

[a] The ore from Panama, Bolivia, Chile, and most of that from Peru, is probably from Bolivia; that from China, Hongkong, England, and half of that from Japan is probably from China.

By countries of origin the imports of 1921 were probably as follows: Argentina, 57 tons; Bolivia, 221 tons; China, 1,296 tons; Mexico, 40 tons. In most countries tungsten mining was stopped as effectually as in the United States.

Further efforts were made during the year to have a very high tariff imposed on tungsten ore, ferrotungsten and tungsten imported into this country, but the bill was still pending at the end of the year.

The world's production of tungsten ores since 1913 has shown a remarkably sudden rise and a more sudden fall. The great peak of production was reached in the year the war ended; the production of the following year, 1919, was less than half that of 1918; in 1920 it was less than a third; and although figures are not complete for 1921, enough are on hand to indicate that not more than an eighth as much as in 1918 came on the market.[1]

World's production of tungsten ore, 1913-1921, by metallogenic provinces and political areas, in metric tons (2,204.6 pounds) of concentrates containing 60 per cent of WO_3.

Province and area.	1913	1914	1915	1916	1917	1918	1919	1920	1921
ASIA.									
Japo-Korean province:									
Japan	257	204	389	730	763	629	519	170	None.
Chosen (Korea)	.....	.....	67	555	900	1,222	64	5	(a)
Chino-Malayan province:									
China	.....	18	35	109	1,361	10,577	2,654	4,712	2,657
Tonkin	127	162	333	343	433	378	284	139	500
Burma and Shan States	1,572	2,166	2,464	3,464	4,226	4,138	3,623	2,983	673
Siam	280	273	432	530	726	185	221	117	.....
Unfederated Malay States	114	172	159	317	334	1,156	808	296	7
Federated Malay States	248	288	329	524	721	362	480	237	293
Dutch East Indies	6	1	6	47	8	27	41	None.	None.
Indian province: India (excluding Burma)	.....	.....	.....	46	68	44	52	3	.....
	2,604	3,284	4,214	6,665	9,540	18,718	8,746	8,662	4,130
AUSTRALIA.									
Australian province:									
Queensland	533	401	642	456	471	357	344	119	5
Northern Territory	32	45	36	137	252	280	278	245	None.
New South Wales	200	221	99	313	268	279	237	39	.....
Victoria	1	.....	.....	1	.....	5	3	9	.....
South Australia	.....	.....	.....	1	.....	.....	None.	None.	None.
Tasmania	81	56	112	144	286	440	379	209	12
Western Australia	1	1	.....	.....	.....	6	8	.....	.....
	848	724	889	1,052	1,277	1,367	1,249	621	17
OCEANIA.									
Oceanic province: New Zealand	262	242	230	315	235	170	155	12	.....
SOUTH AMERICA.									
Cordilleran province:									
Chile	.....	.....	.....	9	2	.....	.....	.....	.....
Argentina	575	437	169	854	1,056	632	204	182	.....
Bolivia	297	290	859	3,288	4,215	3,703	2,161	766	100
Peru	324	213	413	532	427	256	139	77	.....
Brazilian province; Brazil	.....	.....	.....	5	.....	.....	.....	.....	.....
	1,196	940	1,441	4,688	5,700	4,591	2,504	1,025	100
NORTH AMERICA.									
Southwest American province:									
Mexico	.....	.....	140	159	308	239	31	30	14
United States	1,394	898	2,116	5,330	5,545	4,578	297	196	None.
Alaskan province: Alaska	.....	.....	.....	43	29	13	None.	None.	None.
Canadian province: Southeastern Canada	11	.....	.....	.....	.....	15	None.	None.	None.
	1,405	898	2,256	5,532	5,882	4,845	328	226	14

a One-fourth metric ton.

[1] For more complete data see pp. 513–564.

World's production of tungsten ore, 1913–1921, by metallogenic provinces and political areas, in metric tons (2,204.6 pounds) of concentrates containing 60 per cent of WO_3—Continued.

Province and area.	1913	1914	1915	1916	1917	1918	1919	1920	1921
EUROPE.									
Scandinavian province:									
Norway	3	5	.....	1	1	.....	.....	.....	.....
Sweden	.....	.....	.....	.....	.....	3	30	33	.....
Franco-Cornish province:									
England	197	222	360	407	245	307	177	83	.....
France	160	145	126	162	261	45	70	23	.....
Iberian province:									
Portugal	1,126	667	953	1,418	1,580	1,150	706	237	.....
Spain	169	135	189	425	446	534	302	57	.....
Italy	.....	.....	.....	5	1	.....	.....	.....	.....
Erzgebirgan province:									
Germany	96	108	193	330	300	300	.....	.....	.....
Austria	52	57	14	10	10	10	.....	.....	.....
Russian province: Russia	.....	.....	.....	33	33	33	.....	.....	.....
	1,803	1,339	1,835	2,791	2,877	2,382	1,285	433	.....
AFRICA.									
South African province:									
Rhodesia						.....	.....	17	17
Southern Rhodesia	5	.....	1	3	12	37	20	17	.....
Union of South Africa						17	4	None.	None.
Nigeria						None.	32	.....	.....
	5	.....	1	3	12	54	56	34	17
	8,123	7,427	10,866	21,046	25,523	32,127	14,323	11,913	4,278

NOTES ON WORLD'S PRODUCTION OF TUNGSTEN ORE.

Japan.—1919: Japanese Bur. Mines, Dept. Agr. and Commerce, The mining industry of Japan in 1919, Tokyo, pp. 65–66. Figures as given: Exports of tungsten ore, 169,120 kwan [634 metric tons], value 1,033,163 yen. (Kwan = 8.2673 pounds; yen = 2.048 shillings, or, at normal exchange, 49.84 cents.) The mines producing tungsten ores are given (pp. 16–30) as follows:

Tungsten ores produced in Japan in 1919.

Name of company.	Name of mine.	Location.	Quantity (kwan).	Value (yen).
Mitsubishi Mining Co	Takatori	Ibaraki	24,967	140,889
Mitsui Mining Co	Kamioka	Gifu	3,658	11,197
Yebisu Mining Co	Yebisu	do	4,785	34,548
Tanaka Steamship & Mining Co	Kiku	Yamaguchi	41,632	166,269
Awamura Mining Co	Kiwada	do	38,084	158,048
Tanaka Mining Co	Kuga	do	25,325	100,602
			138,451	611,553

The figures of this table have been used. The material is considered as 65 per cent WO_3.

1920: Charles B. Warren in a letter to the Department of State, dated June 6, 1922, gives the figures for production during 1920, furnished by the Japanese Government, as 41,984 kwan, value 145,006 yen. The exports for 1920 are given by the Japanese Department of Finance (Monthly return of the foreign trade of the Empire of Japan for December, 1921, pp. 24–25) as 1,418 piculs, value 88,082 yen.

There were no exports in 1921.

Chosen.—1918–19: Ball, Edward, letter dated March 24, 1921. Figures furnished by Mining Bureau, Imperial Japanese Department of Agriculture and Commerce. Figures as given: 1918, exports, 1,007 [long] tons; 1919, tungsten ore, 15,630 kwan (129,217 pounds), value 54,625 yen.

1920–21: Government General of Chosen, Tables of trade and shipping of Chosen, December, 1921, pp. 18–19. Figures for exports as given: Tungsten ore, 1920, 8,470 kin, value 3,525 yen; 1921, 443 kin, value 45 yen. Considered as 65 per cent WO_3. The kin is 1.31 pounds avoirdupois.

China.—China Maritime Customs, Foreign trade of China 1, Statistical series, Nos. 2 to 5, pt. 1. Report and abstracts of statistics, Shanghai, for 1919 (p. 16) 1920 (pp. 15–16), and 1921 (p. 24). Figures as given: 1918, 155,485 piculs of wolfram; 1919, 39,020 piculs; 1920, 69,273 piculs; 1921, 39,054 piculs. Considered as 67.5 per cent WO_3.

Tonkin.—Kircher, M., Rapport sur la navigation et le mouvement commercial de l'Indochine pendant l'année 1919: Gouv. gén. Indochine, Bull.Écon. Indochine, 23e année, No. 145, p. 842, 1920; No. 151, p. 738, 1921. Exports, figures as given: Étain et wolfram, 1918, 284 tonnes; 1919, 316 tonnes; 1920, 1,512 quintaux. Minerai de tungstène (wolfram) 1918, 1,436 quintaux; 1919, 461 quintaux; 1920, 625 quintaux. The mixture of tin and wolframite given in 1920 included the 625 quintaux given separately. The wolframite is considered as 72 per cent WO_3; the tin and wolframite as containing 72.6 per cent of concentrates carrying 60 per cent WO_3, which was the average content of the mixed concentrates in 1917.

1921: Mining in Indo-China: Min. Jour. [London], vol. 138, p. 685, September 9, 1922. Figures as given: Tin and tungsten ore, 602 tons. This treated, as in former years, as being equivalent to about 83.5 per cent of concentrates carrying 60 per cent WO_3.

Burma.—1919: Pascoe, E. H., The mineral production of India during 1919: India, Geol. Survey Rec., vol. 51, pt. 3, p. 179, 1921. Figures as given:

	Long tons.	Value.
Kyaukse	0.2	£10
Mergui	194.4	30,284
Southern Shan States	397.6	57,254
Tavoy	2,889.5	441,572
Thaton	48.1	10,037

The concentrate from the Shan States is thought to represent the wolframite in a wolframite-cassiterite concentrate and is considered as 65 per cent WO_3. The content of WO_3 in the Burmese ores was formerly only about 50 per cent, the concentrates containing also 15 to 20 per cent of tin. Magnetic separators have been erected, and how much WO_3 the concentrates now carry is unknown, but they are tentatively considered as carrying 65 per cent WO_3.

1920 and 1921: India Dept. Statistics, accounts relating to the sea-borne trade and navigation of British India for the calendar year 1921, p. 81, Calcutta, 1922.

In 1920, 3 long tons of wolframite concentrates, valued at 2,500 rupees, were exported from Sind, and 2,936 long tons, valued at 40,74,250 rupees, from Burma. In 1921 the entire shipments of tungsten ore from British India were 662 long tons, valued at 9,62,512 rupees, from Burma.

Siam.—Royal Dept. Mines, by correspondence. Figures as given: Siamese year 2462 (Apr. 1, 1919, to Mar. 31, 1920), wolframite, 3,652 piculs, value not given; Siamese year 2463 (Apr. 1, 1920, to Mar. 31, 1921), wolframite, 1,936 piculs, value 132,957 ticals. The picul is 133⅓ pounds; the tical is 37.09 cents. The concentrate is considered as 70 per cent WO_3.

Unfederated Malay States.—1919 and 1920: Data obtained through Ernest L. Harris, consul general at Singapore. Figures as given:

State.	1919		1920	
	Piculs.	Value.	Piculs.	Value.
Johore	5.2 (wolframite)	$386	None.	.....
Kedah	2,487 (wolframite, 68 per cent WO_3).	(a)	1,744	(a)
Kelantan	None.	.....	None.	.....
Perlis	None.	.....	None.	.....
Trengannu	553 long tons	611,670	153	$102,582

a Unknown.

The Straits dollar is used, equivalent to 2s. 4d. The picul is 133⅓ pounds.

1921: Bri ish Malaya, return of foreign imports and exports for the month ended December 31, 1921, p. 231. Exports, 110 piculs, value $2,201 (Straits dollars). Considered as 68 per cent WO_3.

Federated Malay States.—Statistical Dept., Board of Trade, statistical abstract for the several British over-sea dominions and protectorates in each year from 1905 to 1919, No. 55, pp. 434–435, London, 1922. Figures as given: 1918, exports, scheelite, 1,874 piculs, value $155,465; wolfram, 4,097 piculs, value $299,964. The picul is 133⅓ pounds; the Straits dollar is indicated by the dollar sign. The concentrates are considered as 60 per cent WO_3, but may have been richer.

1919: Federated Malay States Chamber of Mines, Yearbook, 1919, p. 92.

1920: Federated Malay States report on the administration of the mines department and on the mining industries for the year 1920: Govt. Gazette, Kuala Lumpur, June 17, 1921, pp. 5–6.

1921: British Malaya, return of foreign imports and exports for the month ended December 31, 1921, p. 231:

Collecting station.	1919 (exports).		1920			1921 (exports).	
	Wolfram.	Scheelite.	Production (tungsten ores).	Exports.		Wolfram.	Scheelite.
				Wolfram.	Scheelite.		
Perak	107.24	6.48	3,650				588.35
Selangor	3,367.14	3,830.71	1,641	1,905	2,019	2,822.69	1,430.44
Negri Sembilan	11.54		1,054				
Penang							
	3,485.92	3,837.19					

The figures represent piculs (133⅓ pounds). Content of WO_3 unknown. Considered as 65 per cent.

Dutch East Indies.—Letter from B. Gratama, assistant commercial attaché, Netherlands legation, Washington, dated Feb. 27, 1922. Figures as given: May, 1917, to May, 1918, 8 tons [metric?] wolframite; May, 1918, to May, 1919, about 30 tons [metric?] wolframite; May, 1919, to December, 1919, about 30 tons [metric?] wolframite. The Billiton Tin Co.'s mine, the only producer, was closed in December, 1919. Contents of WO_3 unknown, but considered as 65 per cent. The output is proportioned to the calendar years.

India.—See references under "Burma." The figures as given are: 1919, Bihar and Orissa, Singhbum, 1.5 long tons, value £387; Rajputana, Marwar, 45.5 long tons, value not available. 1920, Sind, 3.0 long tons, value 2,500 rupees. Considered as 65 per cent WO_3.

Queensland.—1919 and 1920: Under Sec. Mines, Ann. Rept. for 1919, p. 24, Brisbane, 1920; for 1920, p. 26, 1921. Figures as given: 1919, wolfram, 228.5 long tons, value £40,596; bismuth and wolfram, 139.9 tons, value £18,681; scheelite, 12.75 tons, value £2,331. 1920, wolfram, 80.65 tons, value £14,027; bismuth and wolfram, 49.05 tons, value £4,756; scheelite, 2.425 tons, value £462. The wolframite and scheelite are considered as carrying 65 per cent WO_3, and the "bismuth and wolfram" as being half wolframite concentrates.

1921: Correspondence. Figure given, 4.5 [long] tons wolfram.

Northern Territory.—1918 to 1921. Dept. Mines, correspondence. Figures as given: 1918, scheelite, 2 statute tons, value £350; wolframite, 234.88 statute tons, value £41,315; 1919, wolframite, 234.6 statute tons, value £39,540. Metal present 70 per cent. Evidently the WO_3 content is meant.

New South Wales.—Dept. Mines Ann. Rept. for 1920, p. 3, Sydney, 1921. Figures as given: 1919, scheelite, 80 (long) tons, value £15,193; wolfram, 135 tons, value £22,818. 1920, scheelite, 21 tons, value £3,805; wolfram, 14 tons, value £2,212. Considered as carrying 65 per cent WO_3.

Victoria.—1919 and 1920: Official figures furnished by Secretary for Mines.

Tasmania.—1919 and 1920: Sec. Mines Rept. for 1919, pp. 33, 35; for 1920, p. 37. The production is given as follows: 1919: 120.907 long tons of wolfram, value £19,375; 199 tons of scheelite, value £43,181. The scheelite was obtained from the contact-metamorphic deposits on King Island (between Tasmania and the mainland) and was milled from 27,832 tons of ore. Both forms of concentrates are here treated as carry-

ing 70 per cent WO_3. 1920: 70.89 long tons of wolfram, value £13,626; 105.09 tons of scheelite, value £17,905. As in 1919, the scheelite came from King Island and was the concentrate from 13,853 tons of ore carrying 0.71 per cent WO_3.

1921: Min. Jour. (London), vol. 137, p. 262, 1922. Reported as 10 statute tons wolfram, value £676.

Western Australia.—Dept. Mines Rept. for 1919. Mining statistics, p. 5, Perth, 1920. Figures as given: 1918, 5 [long] tons scheelite, value £720, and ¼ ton wolfram, value £31; 1919, 6 [long] tons scheelite, value £772, and ½ ton wolfram, value £15. Considered as 70 per cent WO_3.

New Zealand.—Minister of Mines, New Zealand, by correspondence. Figures as given, exports of tungsten ore (scheelite), 1919, 130.9 [long] tons, value £29,489; 1920, 10.5 [long] tons, value £1,378. Considered as 70 per cent WO_3.

Argentina.—1918: Official communication. Exports, 563,257 kilos containing 379,377 kilos WO_3 (67.4 per cent).

1919–1920: Robertson, W. H., Consul General, Buenos Aires, correspondence.

Bolivia.—1919: Figures furnished by Pan American Union. Commerce of Bolivia, detailed report, p. 12, Washington, Pan American Union, 1921. Figures as given: Exports, 1919, 1,995 metric tons, value 3,246,502 bolivianos.

1919 and 1920: Boletín comercial, año 4, No. 163, pp. 8–9, La Paz, Dec. 18, 1921. Exports, 1920, 707,556 kilos, value 1,056,510 bolivianos; 1921 (first six months), 53,380 kilos, value 37,607 bolivianos. The quantity for the year 1921 is estimated. Considered as 65 per cent WO_3. The boliviano in 1920 was worth about 35 cents in United States gold coin.

Peru.—Iiminez, Carlos P., Reseña histórico-estadística de la explotación de minerales en el Perú en los cien años de vida independiente: Soc. ing. del Perú Inform. y mem., vol. 23, 1921, table at back. Figures as given: Tungsteno (concentrado 60 per cent), 1919, 139 metric tons; 1920, 77 metric tons.

Mexico.—1919: Am. Chamber of Commerce in Mexico Jour., quoted in Min. Jour. (London), vol. 130, p. 735, 1920. Figures given as 29,292 kilos.

1920 and 1921: Departamento de Minas, Boletín minero, vol. 12, No. 3, opposite p. 324, 1921. Figures as given (first half of year only): 1920, 4,471 kilos; 1921, 13,259 kilos. The American consul at Mexicali, Lower California, reported for the quarter ending Sept. 30, 1920, 30 tons of tungsten ore, valued at $4,500 United States currency. Considered as 65 per cent WO_3.

Sweden.—Kommerskollegium, Bergshantering Berätelse för år 1919, p. 81; för år 1920, p. 81. Figures as given: 1919, Volframmalmslig, 28.226 tons, värde i kroner, 472,760; 1920, Volframmalmslig, 30.536 tons, värde i kroner, 474,736. In 1920 the concentrates (scheelite) were from Uddgruvan (26 tonnes) and Yxsjögruvan (4.536 tonnes). The concentrates from Uddgruvan carried 60 to 70 per cent WO_3, and the others 60 per cent WO_3.

England.—Chief Insp. Mines, Mines and quarries: General report with statistics, pt. 3, output. Figures as given:

1918 (p. 167): Cornwall, 221 [long] tons 17 hundredweight of tungsten ores, valued at £40,145, "average percentage of metal * * * was 60.20 [WO_3]"; Cumberland, 75 tons, valued at £7,900; and Devon, 5 tons 10 hundredweight. "The above figures include 2 tons of scheelite, which contained 1 ton of metallic tin."

1919 (p. 279): Cornwall, 163 tons 10 hundredweight, value £18,703, "average percentage of metal" [WO_3] 63.8; Devon, 2 tons 10 hundredweight, value £262.

1920 (p. 120): Cornwall, 91 tons, carrying 52.2 per cent "metal" [WO_3], value £3,234; Devon, 3 tons, value £290.

France.—1918–1920: Correspondence.

Portugal.—Official figures obtained from Portuguese Government by W. Stanley Hollis, consul general, Lisbon, and forwarded in letter of Oct. 6, 1921. Figures as given: 1919, wolframite, 613.765 metric tons, value 540,882$89, metal content 65–73 per cent; 1920, wolframite, 218.313 metric tons, value 336,418$92, metal content 65 per cent. Of course the "metal content" should be "percentage of WO_3."

Commerce Repts., Suppl. No. 14B, Nov. 3, 1920, p. 9, gives exports of wolframite in 1919 as 770 metric tons, valued at 1,970,140 escudos. On January 3, 1919, the escudo was worth 61 cents, and on December 31, 1919, it was worth 30.4 cents. The concentrates are considered as 65 per cent WO_3.

Spain.—Consejo de minería, Estadística minera de España, año 1919, p. 39; año 1920, p. 39. Figures as given (wolfram):

Provincia.	Toneladas.	Valor á boca-mina (pesetas).	Valor por tonelada (pesetas).	Ley media (por ciento).
1919.				
Badajoz	230	.....	.....	(a)
Cáceres	2	3,000	1,500	55
Orense	25	30,000	1,200	50–60
Pontevedra [b]	80	201,600	2,520	60
	337	234,600	.....	.....
1920.				
Coruña [b]	14,000	21,000	1,500	60
Pontevedra [b]	46,500	24,200	2,025	60
Salamanca	1,700	1,700	.....	58–60
	62,200	46,900	.....	.....

[a] 58 per cent in 1918 and so considered this year.
[b] Procede de minas de estaño.
The tonelada is 2,032.2 pounds avoirdupois.

Nigeria.—Cock, E. A. Langslow, Mines Dept., Northern Provinces, Ann. Rept. 1919, 11 pp., Lagos, Nigeria, 1920. "Kano (Nigeria) Tin Areas, Ltd.—This company won approximately 114.252 [long] tons of tin ore and 29,261 tons of wolfram, which they export as a mixed ore for separation in England. They are the only company working a definite lode." The ore is said to carry 65 per cent WO_3.

Rhodesia.—Min. Jour. (London), vol. 136, p. 81, 1922. Figures as given: 1920, 17 [short] tons, value £1,519; 1921, 17 [short] tons, value £800. Considered as carrying 65 per cent WO_3.

Southern Rhodesia.—Min. Jour. (London), vol. 132, p. 81. Figures as given: Tungsten ores, 1919, 20 [short] tons, value £5,103; 1920, 17 [short] tons, value £1,519. Considered as 65 per cent WO_3.

Union of South Africa.—Union of South Africa Sec. for Mines and Industries and Govt. Min. Eng. Rept. for year ended Dec. 31, 1920, p. 34, Pretoria, 1921; 1919, 4,469 [short] tons, value £699. The Union includes Transvaal, Cape Colony, Orange Free State, and Natal.

RADIUM, URANIUM, AND VANADIUM.

By Frank L. Hess.

PRODUCTION.

The output of uranium and vanadium ores in 1921 is estimated at 8,540 tons, containing 109 tons of uranium (256,945 pounds of U_3O_8), 201.5 tons of vanadium (719,720 pounds V_2O_5), and about 33 grams of radium (Ra). The approximate value as ore was probably about $876,000. Radium (Ra), mostly as sulphate, amounting to 35.693 grams was isolated during the year. No vanadium ores as such were produced, and most of the output was carnotite ore from Colorado; a smaller quantity was shipped from Utah. Some uranophane ore was mined at Lusk, Wyo., but a considerable part of it was left in storage at Denver, and none was sold.

The output of uranium and vanadium ores in 1920 was estimated at 35,076 short tons, containing 143.5 tons of uranium (338,240 pounds of U_3O_8), 526.7 tons of vanadium (1,819,535 pounds of V_2O_5), and about 43.4 grams of radium. The approximate value as ore was probably about $2,401,000. Radium in various salts amounting to 32.539 grams was isolated during that year.

Several of the larger companies operating in the carnotite fields continued operation during all or most of 1921 in spite of the poor business conditions.

The Standard Chemical Co., the largest operator, closed its mines late in October. The Radium Co. of Colorado closed its camp in Long Park early in the fall and carried on only minor operations at its Calamity Creek camp. The Carnotite Products Co., formerly the Tungsten Products Co.,[1] combined with the Radium Co. of Colorado, and business was continued under the latter name. The camp of the United States Radium Corporation in Long Park was operated through the year. The W. L. Cummings Chemical Co., with claims in Bull Canyon, Gypsum Valley, and Hamm Canyon, did not mine on any of its claims during the year, nor did the Chemical Products Co. operate on its properties on Temple Mountain, Utah. The ore at Temple Mountain is found in Triassic conglomerate and primarily occurs in sedimentary asphaltite. This rock on weathering, gives rise to a number of uranium and vanadium minerals, including uvanite, carnotite, hewettite, and others. The uranophane deposits at Lusk, Wyo., were worked but little during the year owing to litigation. The deposits of torbernite and autunite in the White Signal district of New Mexico were prospected, but no shipments of ores were made.

[1] In 1920 the Tungsten Products Co. took over the business of the Carnotite Reduction Co. of Chicago, erroneously stated in these reports to have been absorbed by the Radium Co. of Colorado.

Some of the material was used in a sanitarium at Silver City for making radioactive water for external and internal application in disease.

Some exploration and prospecting work was done at numerous points in Utah, but the production reported was small. Most of it came from the property formerly owned by Senators Kearns and Clark, now owned by the Radium Co. of Colorado, on Dry Creek, between Moab and Monticello. Smaller quantities came from the property of the Keystone Metals Reduction Co. on Polar Mesa, on the north side of the La Sal Mountains, from H. W. Balsley's claims on the south side of the La Sal Mountains, and from Sayer & McKeever's operations on the San Rafael Swell. The total shipments from Utah, as reported to the United States Geological Survey, amounted to 373 tons, probably averaging somewhat less than 2 per cent of U_3O_8 and 4 per cent of V_2O_5.

Newly discovered carnotite deposits with the usual accompanying vanadium minerals extend for a number of miles on the east and west sides of Carrizo Mountain, N. Mex.-Ariz., on both sides of the State line. They were prospected during the year and were examined for several companies. No shipments were made. The deposits are much richer in vanadium than in uranium, and the claim owners base most of their hopes for profit on the vanadium. The deposits occur in rocks of the same age as those of the Paradox region in Colorado.

Deposits were reported to have been found in the Lukachukai Mountains, Ariz., south of Carrizo Mountain, but no details are at hand.

No production is known to have been made during the year from the vanadinite deposits, of which a considerable number are known through the Southwest, although none have been proved to be very large.

The quantity of radium in salts produced during the year was greater than the quantity of radium in the ores mined. It was produced by the Standard Chemical Co., Pittsburgh; Radium Co. of Colorado, Denver; United States Corporation, 58 Liberty Street, New York City; W. L. Cummings Chemical Co., Sixteenth and Arch Streets, Philadelphia; and Keystone Metals Reduction Co., Cheswick, Pa. Most of the radium was produced as sulphate, and a smaller quantity as bromide.

Physicians and surgeons, to whom most of the radium is sold, were affected like others by the bad business situation of the year, and European financial conditions were so bad that radium was not bought nearly as fast as it was produced; a considerable stock was therefore left in the hands of the producers.

Like the State of New York in 1920, the city of Philadelphia bought 2 grams of radium in 1921—25 milligrams in the form of anhydrous radium sulphate and the remainder in the form of anhydrous radium bromide. The radium was bought under sealed bids, and the contract was awarded to the Radium Co. of Colorado July 29 for $154,000. The radium bromide is kept in solution at the Philadelphia General Hospital, and the emanation is pumped off every other day and sealed into capillary tubes or seeds." These are used both by permanent embedding in diseased tissue and in certain forms of applicators. The Philadelphia General Hospital serves especially

the poor of the city, and radium treatment, necessarily very costly under ordinary circumstances, is brought within the reach of those of small means.

It is greatly to be hoped that other municipalities or units of government will also buy radium, so that its use may be available to many more of the needy. Some well-to-do philanthropists have given radium to hospitals in which they were interested, and as its value becomes better known similar gifts will probably be made by others.

In May the women of America bought through popular subscription and presented approximately a gram of radium (1,010.1 milligrams) to Mme. Marie S. Curie, who, with her husband, discovered the element. The radium was purchased from the Standard Chemical Co.

FOREIGN DEPOSITS.

The mining and isolation of radium is confined to so few firms and the sales are confined to so few buyers that competition of foreign deposits is of intense interest to those concerned in the industry.

Deposits of pitchblende on the Terrazas estate at Placer de Guadalupe, 90 miles southwest of Chihuahua, Chihuahua, Mexico, were examined by American engineers during the year, but it was reported that too little ore was found to make the mine worthy of much consideration.

The pitchblende mines at Jachymov (Joachimsthal), formerly under the control of Austria, have passed to Czechoslovakia. The production is said[1] to be at the rate of 2 grams a year, "and a scheme is being elaborated and finding favor under which the radium produced will merely be lent to foreign countries at charges which will cover the cost of production plus an agreed profit."[2]

As nearly as can be obtained from various reports, the production of radium in Joachimsthal since 1909, the first year for which a record of output is available, has been as follows:[3]

	Grams.		Grams.
1909	0.7217	1916–17	1.4199
1910	1.2937	1917–18	2.7749
1911	2.0144	1918 (last 6 months)	.0459
1912	1.6977	1919	.9689
1913	2.1174	1920	2.2310
1914 (first 6 months)	.8751	1921[4]	3.2
1914–15	1.7118		
1915–16	1.4013		22.4737

In Cornwall some work was done on the uranium ore (pitchblende) found in close connection with the tin deposits, but so far as known no radium was produced. An officer of the Société industrielle du radium (Ltd.), estimated that 5 grams of radium was contained in its mined ore, though the tenor of the ore was not given. The intention was announced of erecting a radium plant to begin output in March, 1923.[5]

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[1] Breed, F. L., Radium production in Czechoslovakia: Commerce Repts., Nov. 21, 1921, p. 726.

[2] Min. Jour. (London), vol. 133, p. 418, June 4, 1921.

[3] Statistik des Bergbaues in Oesterreich for various years; also Winans, C. S., American consul, Prague. At the outbreak of the great war the radium mines were placed under military control, so that the figures for the first six months of 1914 are given separately, those for the time between that and July 1, 1918, by broken years, and those for the last six months of 1918 separately.

[4] Econ. Review, vol. 5, p. 506, Apr. 14, 1922. Quoted from the Gazette de Prague of March 22, 1922. It is stated that the Czechoslovakian Government now has on hand 6 grams of radium.

[5] Min. Jour. (London), vol. 135, p. 997, Dec. 31, 1921.

Concerning the radium-bearing minerals of Madagascar little information has hitherto been available. The following account is a translation of an article by the noted French mineralogist and geologist E. Lacroix,[6] which came to hand in 1921:

So far neither pitchblende nor carnotite has been found in Madagascar. Autunite is found in commercially important quantities in a single deposit. * * * The radioactive minerals of the Grande Isle belong essentially to the group of the titano-columbo-tantalates, and those that do not belong to definite species have the peculiarity of generally being richer in uranium than the same compounds elsewhere.

The first radioactive minerals found in Madagascar were those which I made known in 1908 and which were a fragment of what I now call "betafite" (Mont Bity) and a specimen of euxenite, which I found among the granite rocks sent from the province of Analalava to the museum by Captain Colcanap; shortly thereafter (1910) I described, referring it doubtfully to blomstrandite (a little-known mineral from Sweden), a compact substance of a greenish-brown color from Ambolotora, in the region of Betafo, which Mr. Buhan had sent me.

A few months later I undertook my exploration of the Grande Isle, and I then found in abundance in various beryl workings all the minerals which I shall consider. Three of them were new to science. I have described them successively under the names betafite, samiresite, and ampangabeite.

Attention once having been drawn to these minerals and their probable industrial value, discoveries of them multiplied. Formerly curiosities, they have become exploitable minerals, of which a number of tons have been exported. In spite of the efforts which I made in 1911 on my return to France to find buyers for the prospectors who had received me so cordially, no one in Paris then seemed to realize the value of this type of ore, because the new minerals demanded a special treatment, disturbing established habits. The war delivered us from that which generally intervenes in such circumstances, the enterprise of German commerce and industry, less timid than ours.

The minerals of the titano-columbo-tantalate class possess certain characters in common which readily attract attention. Their density is greater than 4 when they are not too much altered; they all possess a brilliant greasy luster, due to their high refringence. Generally their color is black, but some are deep brown. Even when they do not belong to the isometric system, they are ordinarily isotropic, but certain of them take on or rather resume the birefringence appropriate to their symmetry and become denser when heated red hot, which causes them to lose their water of hydration. At that moment they develop a brilliant incandescence. They are what one calls pyrognomic minerals. They share this property with certain silicates of the rare earths (gadolinite, allanite, etc.).

It is rather amusing to recall that as all the known deposits of these minerals 60 years ago had been found in Norway and Greenland, Leymerie proposed to distinguish them under the generic name of "borean" minerals. To-day their principal deposits are found in the tropical regions.

The previously known species which I found in Madagascar are fergusonite, samarskite, and euxenite. The least common is fergusonite, occurring in sharp, tetragonal hemihedric pyramids of a yellowish-brown color. It is a columbate of calcium $(CbO_4Y)_2,Cb_2O_7Ca_2$, poor in uranium, and is the least radioactive of the series.

Samarskite, orthorhombic, also is rare. It is a rather uraniferous tantalo-columbate of yttrium and calcium, $(Cb, Ta)_2O_7$ [Ca, Fe $(UO)]_2.(CbO_4Y)_2$.

Much more abundant but variable in its content of uranium is euxenite, which differs from samarskite in being a meta-columbate associated with a considerable quantity of titanate, $[(Cb, Ta)O_3]_2$ $[Ca(UO)].[CbO_3]Y.[TiO_3]_3Y_2$.

The minerals peculiar to Madagascar are betafite[6a] (from the neighborhood of the town of Betafo), of which the octahedral crystals modified by the faces of the rhombic dodecahedron sometimes are larger than one's fist. It is a deep-brown mineral, growing yellow with alteration. Samiresite (from Samiresy) is a variety of it very rich in columbic acid, poor in titanium and tantalum, and containing lead. In blomstrandite columbic and tantalic acid exist in nearly equal proportions. Ampangabeite (from Ampangabe), more or less dark-brown red, is orthorhombic and generally intimately grouped with columbite. It is a columbate of uranium, rich in iron, containing a small quantity of titanium and of tantalum.

All these minerals originated in the potassic pegmatites containing beryl, muscovite, and black tourmaline.

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[6] Lacroix, E., Les industries minérales nonmetallifères à Madagascar: Bull. écon. de Màdagascar, vol. 17, pp. 48 et seq., 1920.

[6a] Betafite as described by Lacroix in his Minéralogie de la France et de ses colonies, vol. 5, pp. 72–73, 1910, carries 23.3 per cent Cb_2O_5, 28.5 Ta_2O_5, 10.80 TiO_2, 18.10 UO_3, and small quantities of rare earths, lime, etc.

Like the other accessory minerals of that rock (monazite, ilmeno-rutile, strueverite, and almandite-spessartite) they are not uniformly distributed but often occur as segregations easily extracted and in these are often intimately associated with the micas.

Alteration, which has transformed the pegmatites to red earth or which has only modified them without making them lose their general appearance, has also hydrated these minerals, and the comparison of the analyses * * * with those of similar species from other deposits shows that the minerals of Madagascar often contain an exceptional quantity of water. To this intense hydration they owe the modifications of certain of their characters; their black color becomes brown and then yellow and sometimes a very light yellow, whatever may have been their original color; from hard they become friable; from resistant to the action of acids they become more or less easily attacked, and the richer they are in water the more easily they are attacked.

Undoubtedly this hydration is accompanied by chemical transformations, for the radioactivity of a large crystal more hydrated in its periphery than at the center is always less in the more hydrated portion, either because the tenor of uranium has diminished or because the ratio between radium and uranium has been lowered in the more altered parts of the mineral, which would conform rather well to the modern ideas on the age of the minerals. This is an open question, which will be later solved by analyses now under way.

The chemical study of all these minerals has only begun. In the table below I give some measurements of radioactivity, taking as unity the quantity of radium which should be present with such a content of uranium oxide (U_3O_8), as is found in the mineral.[7] The variations for the same species are probably due on the one hand to the phenomena of hydration and on the other to chemical variations which result in a given deposit from isomorphic replacements among the numerous elements entering into the composition of these minerals.

Betafite	0.96 to 0.64	Ampangabeite	0.61 to 0.32
Blomstrandite	.64	Fergusonite	.48 to .27
Samiresite	.50	Samarskite	.24
Euxenite	.50 to .32		

The exploitation of all these minerals is easy on account of the decomposition of the pegmatites which contain them and of the abundance of alluvial deposits. Generally they are a by-product of the mining of beryl. The large fragments, usually consisting of sharp crystals, are removed by hand, and the small ones are isolated by washing.

In Madagascar radioactive minerals are found in almost every place where there are pegmatites carrying beryl, but the deposits which to-day furnish almost the entire product are located between Lake Itasy and Antsirabe. The deposit richest in betafite is that of Ambatofotsy, developed by Mr. Dreyfus. It has already yielded 20 tons of crystals.

The difficulty which the Madagascar minerals have had in obtaining a place on the market appears to be due to two reasons—on the one hand, to their composition, which compels a new and more complex system of chemical treatment than that in use for autunite and carnotite; and on the other hand, to the presence of a small quantity of thorium, the disintegration of which furnishes mesothorium, whose radioactivity is added to that of the radium. The rapid methods used to determine the radioactivity of the ores do not permit distinguishing that due to each of these two bodies, and the separation of radium and mesothorium is at present impossible; but the life of mesothorium being less than that of radium, the result is that the salts of radium containing mesothorium suffer from a loss of radioactivity with time and as a consequence have less value, especially when the salts are sold for medical use.

According to the statistics of the Bureau of Mines, the production of the minerals in Madagascar has been as follows:

	Kilograms.		Kilograms.
1912	11	1915	1,209
1913	5,000	1916	1,221
1914	8,861	1917	7,280

[7] These measurements were made in my laboratory and have been verified by measurements made on the same specimens by skillful specialists, namely, Miss Ellen Gleditsch and Messrs. Muguet and Szilard. Mr. Muguet, who has already initiated a mode of treatment of the Madagascar minerals, has published his measurements in his book "Radioactivity and the principal radioactive substances," Paris, 1917.

The value of an ore of radium is generally calculated on its tenor of U_3O_8, which permits, as was shown above, an estimate of the quantity of radium contained, except for the allowance which it may be necessary to make for the mesothorium that may accompany it. The prices paid for the ores from Madagascar have fluctuated between 20 and 60 francs per unit [10 kilos] of U_3O_8.

Sometimes the mineral is sold on the basis of its content of radium, the unit then being the milligram per ton.[8] The quotations estimated on this basis have been from 100 to 200 francs per unit for ore as sold in a French port. Certain betafites have sold as high as 15,000 francs a ton.

It remains for me to consider the deposit of autunite of Vinaninkarena, to the southeast of Antsirabe. It occurs under most unusual conditions, of which I know no parallel. Near its confluence with the Manandona the little rivulet of Fitatahana has eroded its channel in a layer of alluvium 20 meters thick which rests on the gneissic granite traversed by the pegmatites. This alluvium consists of a horizontal succession of gravels, fine sands, and clay beds, with intercalations of thin peat beds. The autunite is found in a bed of white sandy clay at the base, in the middle of which are the beds of peat. Autunite in little flakes impregnates the rock and especially the peaty beds for a thickness of a meter.

It is concentrated in numerous shrinkage fissures, in wormholes, and in the cylindrical cavities left by the disappearance of roots, forming so many geodes. Slightly plastic when it is saturated with moisture, this gangue, when one breaks it, appears to be covered with yellow flakes of autunite having a green fluorescence and with a freshness and brilliance unknown in specimens in collections. Once it becomes dry it is friable and difficult to transport without crumbling.

This deposit appears to be due to the precipitation by phosphatic particles in the alluvium of the small quantity of uranium resulting from the decomposition of the uraniferous titano-columbo-tantalates contained in the pegmatites of the basin of the ancient Lake Antsirabe. The radioactivity of the sediment is often greater than conforms to its content of autunite flakes, which hardly exceeds 1.5 per cent.

It is probable that the phosphate of uranium is first precipitated in a colloidal condition and that it remains in part in this form. This type of deposit affords an explanation of the origin of uranium that is found in the variety of lignite of Sweden known as kolm[9] and probably also of the uraniferous sedimentary deposits of the type of the carnotite deposits.

When I visited the deposit Mr. Helson was trying to concentrate the ore by passing it over a shaking table. Since then this attempt has been abandoned. It is probable that this deposit could be developed industrially if, as in the case of the uraniferous pegmatites of Portugal, it were possible to give a first chemical treatment at the mine, after which it would be only necessary to send the sulphate of barium that carries the radium to a metropolitan factory for final treatment.

During the year the uranium-bearing veins in Katanga, Belgian Congo, were briefly described by H. Buttgenbach[10] and appear to be of primary importance. A brief digest of the article follows:

The Union minière du Haut Katanga found uranium minerals at its Luswishi (Luiwishi) copper mine, a few kilometers north of Elisabethville. Several small veins 30 centimeters (1 foot) wide were filled mostly with uranium oxide. The uranium minerals are apparently pitchblende and its alteration products. The original mineral was apparently in aggregates of cubical crystals, and these have altered to uranophane on the outside and gummite on the inside, with small cores, a few millimeters thick, of pitchblende. The outer coating extends into minute cracks traversing the gummite. The radioactivity is greatest in the pitchblende and successively less in the gummite and uranophane. Buttgenbach considers the Lus-

[8] To determine the radium the ore is melted with pure carbonate of sodium, then taken up with water, which leaves the radium insoluble in the state of a carbonate. The insoluble residue is treated with hydrochloric acid and the radium determined in this solution by means of its emanation.

[9] The kolm of Sweden, at least that from the vicinity of Ulunda and Vastergotland, is not, as Lacroix supposes, a lignite but is an asphaltite somewhat like one found near Hayfield, south of Palisade, Nev. It is harder and has lost more volatile matter than that at Page, Okla., or most of the Peruvian asphaltites generally referred to as "coal." It is more similar to the asphaltite at Temple Mountain, Utah.—F. L. H.

[10] Buttgenbach, H., Note préliminaire sur des minerais d'uranium et de radium trouvés au Katanga: Soc. géol. Belgique Annales, vol. 44, 5 pp., 1921. Abstract translation in Min. and Sci. Press, vol. 123, pp. 636-637, 1921.

wishi ore to contain 192 milligrams of radium per ton. Prospecting at Luswishi was interrupted by the war, but in 1915 a similar discovery was made at Shikolowe (Kasolo), south of Kambove. At Shikolowe "the vein assumes the shape of a rosary, with swellings and pinches." The inclosing rocks are talcose schist, dolomite, and breccia, greatly faulted and impregnated with copper, cobalt, and manganese minerals. The strata have a north dip, and the uraniferous veins dip 20°–45° S. In the swellings the vein is almost entirely filled with gummite, and in the pinched places by a micaceous mineral that may be torbernite or autunite.

A plant for manufacturing radium salts from the Katanga ore has been established at Oolen, near Hoboken, Belgium, and ore has been shipped with which to begin operations.

Two new minerals, curite, a hydrous lead uranate ($2PbO.5UO_3.4H_2O$), and kasolite, a hydrous lead uranium silicate ($3PbO.3UO_3.3SiO_2.4H_2O$) were described from specimens of the Katanga ores by Prof. Alfred Schoep.[11]

Radium ores are found in the Guarda and Vizeu districts of Portugal, roughly 150 to 175 miles northeast of Lisbon. The larger part of these ores has been shipped to Paris, and a smaller part to London for treatment. The known minerals are autunite, torbernite, uranocircite, and zeunerite. The first three minerals are, respectively, the hydrous phosphates of uranium and calcium, uranium and copper, and uranium and barium; zeunerite is the hydrous arsenate of uranium and copper and is not common in the mines.

The ores are treated in two lots in Paris—ore in which the autunite and other minerals are visible, and ore in which none of the minerals named above are seen. The latter is called "sulphide" ore. Possibly 10 grams of radium may have been produced from Portuguese ores.

The vanadium deposit of the American Vanadium Co. at Minaragra, Peru, continues to dominate the world's vanadium supply. During the year 5,154 tons of ore, valued at $543,061, was received in this country. This ore was thought to contain between 10 and 12 per cent of vanadium.

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[11] Schoep, Alfred, La curite, nouveau minéral radioactif: Compt. Rend., vol. 173, pp. 1186–1187, 1921; Sur la kasolite, nouveau minéral radioactif: Idem, pp. 1476–1477.

WORLD'S PRODUCTION.

The vanadium production of Peru and of the United States is roughly that of the world, though now and then a few tons of vanadium is produced by other countries. The exports of vanadium ore from Peru, as shown by the Peruvian official publications, and the production in the United States since 1917 are shown in the following table:

Approximate world's production of vanadium, 1917–1921.

Year.	Peru (exports of ore).			United States (vanadium contained in ore and concentrates, short tons).
	Short tons.	Percentage of V_2O_5.	Vanadium contained (short tons).	
1917	4,501	35.78	902	484
1918	2,407	19.10	257	276
1919	3,249	30.41	553	284
1920	11,158	20.43	1,277	527
1921	5,154	[a] 19.64	567	202

[a] Estimated.

Of the world's radium the United States has produced much the greater part; Austria, Portugal, England, and Australia follow in the order named. Some ore carrying tyuyamunite (hydrous calcium-uranium vanadate) has been produced from Fergana, Turkestan, but no radium is known to have been isolated from it. Autunite from Madagascar and Tonkin may have been mixed with the Portuguese ores.

As nearly as can be estimated from the data in hand, the world's radium production has been about as follows:

	Grams.
United States (produced in American factories)	153.857
Produced in foreign factories:	
Czechoslovakia (formerly Bohemia, Austria)	22.474
Bohemian residues worked in France	2.500
Portuguese ores (possibly)	10.000
England (possibly)	3.000
Australia	.600
American ores	6.000
Ores from Madagascar and Tonkin (possibly)	1.000
	199.431

This output is equal to about 7 ounces avoirdupois. Possibly an ounce has been dissipated on watch and clock faces and on gun sights and other war materials, so that the world now has possibly 6 ounces of radium, worth between $17,000,000 and $20,000,000.

IMPORTS.

Value of uranium salts and oxide, including some radium salts, imported for consumption in the United States, 1915–1921.[a]

1915	$17,288	1919	[b]$12,960
1916	5,065	1920	[c]3
1917	2,930	1921	[d]8,552
1918	[e]274		

[a] Statistics furnished by the Bureau of Foreign and Domestic Commerce.
[b] Composed of the value of 154 pounds of "uranium salts and oxide" ($1,309) and of 13 grains of radium salts ($11,651).
[c] Uranium salts only.
[d] "Uranium salts and oxide," 2,790 pounds, $3,253; radium salts 1,716 grains, $5,299.
[e] Radium salts only.

Of "uranium and radium steel-hardening ores" 250 pounds, valued at $446, was imported in 1921. No ferrovanadium or ferrouranium was imported.

Exports of ferrovanadium since 1912 have been as follows:

Exports of ferrovanadium, 1912–1921.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1912	[a]199,056	[a]$170,895	1917	2,427,649	$2,953,260
1913	604,287	455,417	1918	1,512,737	1,774,062
1914	770,079	640,948	1919	64,626	95,560
1915	840,265	741,085	1920	387,060	705,385
1916	2,031,027	2,035,276	1921	220,455	424,886

[a] The last 6 months of the year. Prior to July 1, 1912, ferrovanadium was not listed separately.

COPPER.

By H. A. C. Jenison.[1]

INTRODUCTION.

The production of metallic copper from the ore for general consumption requires at least three distinct operations—mining, smelting, and refining. Each of these operations embraces several processes, of which the preparation of the ore for smelting is ordinarily the most varied and complicated. The Lake Superior native-copper ores are the only important American source of copper in which the three operations are not necessary for the production of commercial copper. On account of these three operations it is possible to determine approximately the production of copper in the United States by the collection of mine statistics, smelter statistics, or refinery statistics. These three sets of statistics can never agree exactly, but each set has a peculiar advantage, and the coordination of all three accurately determines the essential features of the copper industry for the year.

The principal value of the mine statistics is that they determine most accurately the geographic distribution of production. They are also the only source of accurate data on the character of the ore, the copper and precious-metal contents of the ore, and the degree to which the ore is concentrated before smelting. They show the quantity of ore shipped from the mines but are less accurate than the smelter figures in that they represent the estimated recoverable copper content and not the actual recovery. The smelter statistics show with fair accuracy the geographic distribution of the production and give accurately the quantity of crude copper actually recovered from the ores, including considerable copper from sulphur, lead, zinc, and siliceous ores that carry so little copper that the mines are not paid for it and frequently do not report it. The smelter figures also differ from the mine figures by the quantity of ore, matte, and other materials in stock at the beginning and at the end of the year. The refinery statistics indicate the quantity of copper made available for consumption and the quantity of precious metals recovered from copper ore but do not permit accurate distribution of production according to source, even the separation of production according to foreign and domestic sources being uncertain. The refinery figures differ from the smelter figures by the quantity of stocks of unrefined copper at the beginning and the end of each year.

The principal cause of the differences in the figures from the three different sources is the time factor involved in the successive stages of the production of refined copper. The interval from the time the

[1] The statistical tables in this report were prepared by Miss Helena M. Meyer, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the United States Geological Survey.

ore is mined until the refined copper is available for commercial use is about three months. Consequently, whereas the mine figures represent the quantity of copper actually mined each calendar year, the smelter and refinery figures represent the quantity of copper produced during that year from ore part of which was mined near the end of the preceding calendar year. The differences among the three sets of figures, however, should not be very great for any single year when the industry is normal.

As the smelter statistics permit accurate geographic distribution as to source and also represent the actual production of the copper, they are adopted in this report as showing the production of the country. They include the production of blister copper and the furnace-refined or Lake copper.

SUMMARY OF DOMESTIC AND WORLD STATISTICS.

Summary of statistics of the copper industry in the United States, 1913 and 1918–1921.

	1913	1918	1919
Production of copper:			
Smelter output....pounds..	1,224,484,098	1,908,533,595	1,286,419,329
Mine production....do....	1,235,569,727	1,910,022,841	1,212,334,041
Refinery production of new copper—			
Electrolytic....do....	1,022,497,601	1,560,327,422	1,233,994,324
Lake....do....	155,715,286	231,096,158	177,594,135
Casting and pig....do....	58,611,026	91,450,611	21,897,336
Total domestic....do....	1,236,823,913	1,882,874,191	1,433,485,795
Total domestic and foreign....do....	1,615,067,782	2,432,385,290	1,805,306,801
Total new and old copper....do....	1,888,000,000	3,138,000,000	2,380,000,000
Ore produced:			
Copper ore....short tons..	36,336,682	62,289,069	36,121,622
Average yield of copper....per cent..	1.67	1.51	1.65
Average cost per pound of copper produced....cents..	10.24	14.49	15.25
Other ore yielding copper....short tons..	24,419	15,698	17,632
Average price per pound....cents..	15.5	24.7	18.6
Imports (unmanufactured)....pounds..	408,778,954	575,805,115	429,387,594
Exports of metallic copper [a]....do....	926,241,092	744,243,481	515,595,019
Withdrawn from total supply on domestic account:			
Total new copper....pounds..	812,268,639	1,661,669,576	914,471,572
Total new and old copper....do....	1,085,000,000	2,367,000,000	1,489,000,000
Stocks of refined copper [b]....do....	90,385,402	180,000,000	631,000,000
Stocks of blister and materials in solution [b]....do....	247,789,811	562,600,000	273,000,000
World's production....do....	2,181,253,000	3,148,499,000	(c)
Value of production in the United States....	$189,795,035	$471,408,000	$239,274,000

	1920	1921
Production of copper:		
Smelter output....pounds..	1,209,061,040	505,586,098
Mine production....do....	1,224,550,151	466,190,853
Refinery production of new copper—		
Electrolytic....do....	1,010,240,867	506,532,984
Lake....do....	153,483,952	100,918,001
Casting and pig....do....	18,698,421	1,963,271
Total domestic....do....	1,182,423,240	609,414,256
Total domestic and foreign....do....	1,634,908,644	1,020,027,096
Total new and old copper....do....	2,260,000,000	1,455,000,000
Ore produced:		
Copper ore....short tons..	36,765,370	13,396,382
Average yield of copper....per cent..	1.63	1.70
Average cost per pound of copper produced....cents..	14.94	(c)
Other ore yielding copper....short tons..	26,890	14,248
Average price per pound....cents..	18.4	12.9
Imports (unmanufactured)....pounds..	485,670,691	350,472,611
Exports of metallic copper [a]....do....	623,158,489	628,415,714
Withdrawn from total supply on domestic account:		
Total new copper....do....	1,053,838,558	610,988,744
Total new and old copper....do....	1,679,000,000	1,046,000,000
Stocks of refined copper [b]....do....	659,000,000	459,000,000
Stocks of blister and materials in solution [b]....do....	465,000,000	283,000,000
World's production....do....	(c)	(c)
Value of production in the United States....	$222,467,000	$65,221,000

[a] Total exports of copper, exclusive of ore, concentrates, and composition metal.
[b] At the end of the year.
[c] Figures not yet available.

Copper produced in the United States from domestic ores, 1913 and 1918–1921.

[Smelter output, in pounds fine.]

State.	1913	1918	1919	1920	1921
Alaska	23,423,070	67,081,648	56,534,992	66,093,924	76,808,114
Arizona	404,278,809	769,521,729	536,515,368	552,988,731	155,165,656
California	32,492,265	44,150,761	23,548,698	11,822,028	15,906,883
Colorado	9,052,104	7,591,570	4,892,558	4,282,616	6,592,598
Georgia	.....	397,078	8,306	3,663	.....
Idaho	8,711,490	5,836,795	3,966,655	1,922,116	1,971,623
Maine	.....	501,169	376,186	.....	3
Michigan	155,715,286	231,096,158	177,594,135	153,483,952	100,918,001
Missouri	576,204	232,073	588,570	533,368	137,591
Montana	285,724,467	326,426,761	176,289,873	177,743,747	49,471,206
Nevada	85,209,536	106,266,603	64,683,734	55,580,322	15,129,116
New Mexico	50,196,881	96,559,580	60,377,320	52,159,751	18,076,909
North Carolina	180	79,200	3,334	.....	.....
Oregon	77,812	2,630,499	2,808,017	2,529,311	274,934
Pennsylvania	245,337	34,500	.....	618,361	.....
South Carolina	.....	.....	2,297	.....	.....
South Dakota	.....	.....	8,631	2,190	.....
Tennessee	19,489,654	15,053,568	15,629,454	16,727,803	15,084,294
Texas	39,008	13,851	2,153	14,217	587
Utah	148,057,450	230,964,908	143,836,304	110,357,748	45,831,959
Vermont	5,771	896,630	582,561	.....	.....
Virginia	46,961	1,248	.....	.....	.....
Washington	732,742	2,330,568	2,552,134	2,125,586	598,658
Wyoming	362,235	866,698	150,051	24,256	9,830
Undistributed	46,836	.....	15,467,998	47,350	3,608,136
	1,224,484,098	1,908,533,595	1,286,419,329	1,209,061,040	505,586,098

World's production of copper (smelter output), 1916–1921, in metric tons.

[Where no footnotes are given, figures are taken from official publications. For countries from which ore or matte was exported for smelting, official figures have been converted to figures showing the quantity of copper recoverable by the smelters. For more complete data see pp. 513–564.]

Country.	1916	1917	1918	1919	1920	1921
Austria	.....	.....	.....	648	1,645	(a)
England	282	190	182	146	129	(a)
France	1,374	1,003	1,228	873	(a)	(a)
Germany	51,339	b 45,000	b 35,000	17,931	(a)	(a)
Italy	1,867	1,331	1,139	1,374	635	c 100
Norway	1,614	1,810	2,856	437	556	(a)
Portugal	b 4,310	b 4,300	b 4,000	b 2,300	(a)	(a)
Russia	b 13,380	b 17,000	d 4,999	(a)	e 3,751	e 4,668
Spain	32,880	38,526	45,104	23,419	22,458	(a)
Sweden	3,181	4,423	2,956	3,558	1,289	(a)
Europe	110,227	113,583	97,464	(a)	(a)	(a)
Canada	53,139	49,545	53,873	34,044	37,014	c 24,250
Cuba	b 9,500	b 10,700	b 13,300	b 7,500	b 8,400	b 8,200
Mexico	28,411	50,986	70,223	56,172	49,192	15,228
United States	874,467	855,539	865,705	583,516	548,426	229,332
North America	965,517	966,770	1,003,101	681,232	643,032	277,010
Bolivia	9,150	10,620	8,422	9,524	10,482	(a)
Chile	71,288	102,527	b 115,000	b 65,800	b 95,000	(a)
Peru	43,078	45,176	44,414	39,230	32,982	(a)
Venezuela	d 1,175	d 2,958	d 2,079	d 188	(a)	(a)
South America	124,691	161,281	169,915	114,742	(a)	(a)
Belgian Kongo	b 22,500	b 27,900	b 20,238	23,028	18,962	30,468
Southern Rhodesia	3,194	3,548	2,952	2,732	2,820	f 2,793
Union of South Africa	10,549	8,101	4,824	3,577	1,075	(a)
Africa	36,243	39,549	28,014	29,337	22,857	(a)
Japan	100,636	108,038	90,341	78,443	67,792	(a)
Australia	40,367	39,860	39,315	19,307	27,047	(a)
Grand total	1,377,681	1,429,081	1,428,150	(a)	(a)	(a)

a Figures not yet available.
b Estimated by the U. S. Geological Survey.
c Preliminary figures.
d Figures from Imperial Mineral Resources Bureau.
e Figures from Min. Jour. (London), Apr. 8, 1922.
f Figures from Min. Jour. (London), Jan. 28, 1922.

GENERAL CONDITIONS.

The character, cause, and effect to date of the business depression that began in the summer of 1920 are too well known to necessitate comment here, but in view of the present critical condition of the copper industry, which is one of the great basic industries of the country, it seems desirable to sketch its history since 1920.

The year 1920 began with a large and promising export market and a selling price of the metal that would permit operation by most companies without loss. During the summer, however, the export market weakened, and by November both the export market and the domestic market had virtually collapsed. The collapse was followed

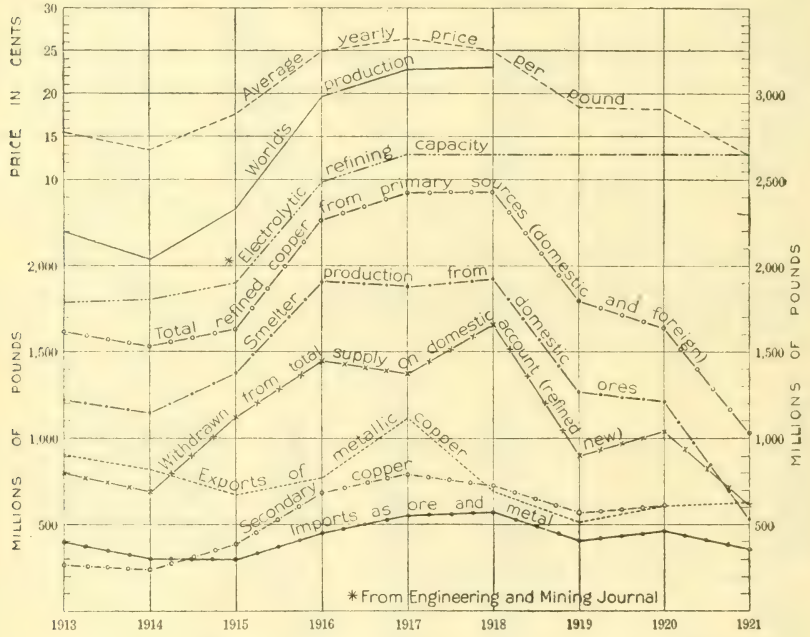

FIGURE 8.—Chart showing the principal features of the copper industry, 1913–1921.

by a great decline in the selling price of the metal. Meantime the production, though greatly reduced as compared with that of the preceding four years, largely exceeded the withdrawals, and the year 1921 began with the smallest consumptive capacity in about 15 years, the greatest stocks in the history of the industry, and a selling price of nearly 2 cents a pound less than the weighted average cost of production for the year 1920, exclusive of depletion. If depletion charges are taken into account, the selling price on January 2, 1921, was about 5 cents less than the weighted average cost of production in 1920. Under such conditions it was inevitable that production should practically cease until the enormous stocks were absorbed, the cost of production lowered, and the selling price increased sufficiently to permit operation without loss. Accordingly, by April 1, 1921, nearly all the large companies had discontinued operations. The extent of the shutdown can best be realized by a comparison of the

smelter production in 1921 with that of previous years. It was followed by an investigation of the industry by the Department of Justice on account of suspected violation of the Sherman Act. It was obvious, however, that continuation of mining under the prevailing conditions could only lead to bankruptcy for many companies and the useless exhaustion of a wasting asset of great national importance at the cost of mining or less for the industry as a whole.

The year 1921 was an extremely critical one for the industry, and the immediate future is still very uncertain. The year was marked by a continuation of the efforts of the producers to stimulate and stabilize the industry and a disastrously low selling price, together with great and, to some producers, almost ruinous losses incurred in keeping the mines open and putting them in condition to meet future demands. Numerous measures were taken by the industry to protect itself, among the most important of which was the withdrawal from the domestic market and pooling for the export market by the principal producers of 400,000,000 pounds of refined copper. This copper was bonded for $40,000,000, upon the guaranty that it would be sold solely in the export trade. The bonds were issued in four equal amounts to mature in one, two, three, and four years at 8 per cent interest, the copper at 10 cents a pound being the security. This measure did much to assist the domestic industry by decreasing the stocks available for domestic trade, by providing needed operating capital, and by relieving the participants from the burden of financing a large part of their stocks. The measure was not so successful in relieving the domestic situation as had been expected, however, as it took the domestic market more than a year to absorb the remaining stocks instead of about six months, as many had hoped. It was exactly one year from the date of the shutdown of most of the companies before the domestic stocks had been sufficiently depleted to warrant resumption of mining operations on a reduced scale. Even at the present time (July, 1922) it is extremely doubtful whether the selling price of copper much more than equals the cost of production exclusive of depletion. Many companies frankly admit that they are mining their highest grade and most cheaply mined ore in an effort to meet the situation.

Other measures of far-reaching consequences were taken by individual companies to protect and stabilize their interests, among which were the absorption of smaller companies and consolidation of larger ones, notably the Phelps Dodge Corporation's acquisition of the Arizona Copper Co. (Ltd.) and the Anaconda Copper Mining Co.'s acquisition of the American Brass Co. The Phelps Dodge action assures a reduction of costs and an economical curtailment of production. The Anaconda's action assures a lower cost of manufactured copper and copper alloys and provides a direct outlet for its mine product. Both measures are wise, provident, and advantageous to the companies concerned and to the general public.

In view of the industry's history for the last two years, it is desirable to summarize the present condition and the future outlook. One of the most salient facts at present is that the productive capacity of the domestic industry is about 25 per cent greater than the combined consumptive capacity of the domestic market and the American export market would have been at this time had there been no war

and had consumption increased by normal increments for the last eight or ten years. Under the present conditions the productive capacity is much more than 25 per cent in excess of the consumptive capacity, and there is no good reason to believe that for several years the consumptive capacity will exceed what it should have been by the addition of normal increments. Under such conditions the selling price of copper can not very greatly increase so long as production by the mines now operating continues. In other words, the excess productive capacity offers too great potential competition to permit more than 70 or 75 per cent of the productive capacity to operate without incurring losses. Under such conditions some of the companies can earn a profit, but most of them, taking depletion into account, must for some time be content to operate without incurring losses. Should the price of copper advance materially, the normal result would be a corresponding increase in production, which, so long as there is excess productive capacity, would undoubtedly result in further and detrimental competition for the market.

One of the great needs of the copper industry at the present time is evidently Government cooperation. The copper industry needs Government assistance in the export trade, particularly in extending credit to European purchasers, and this need appears fundamental, because not only the prosperity but the very life of the industry is dependent upon foreign markets. The industry further needs a more liberal policy, which might permit a reasonable selling price for the metal rather than promote ruinous competition and the maintenance of high costs.

PRODUCTION.

SMELTER PRODUCTION.

The smelter production from domestic ores in the United States in 1921 was 505,586,098 pounds of copper, valued at $65,221,000, making a total since 1845 of 30,107,655,570 pounds of copper, valued at $5,161,283,000. The production in 1921 represented a decrease from 1920 of 703,474,942 pounds.

The figures of smelter production in 1921 are based on returns made confidentially to the United States Geological Survey by all known smelting companies handling copper-bearing materials from the United States. To all companies and officials who have aided in furnishing this information and have given valuable time to answering inquiries concerning distribution of the output sincere thanks are extended. The following list gives the names of the owning or operating companies, the location, and the final copper product of smelting and refining plants treating material from the United States during 1921. It does not include lead and zinc plants that recovered copper as a by-product from mixed ores. Lists of lead and zinc smelters can be found in the reports on those metals.

Copper reduction plants that treated materials from the United States in 1921.

Location.	Company.	Final copper product.
Arizona:		
Ajo	New Cornelia Copper Co	Electrolytic.
Clarkdale	United Verde Copper Co	Blister.
Do	United Verde Extension Mining Co	Do.
Clifton	Arizona Copper Co. (Ltd.)	Do.
Douglas	Calumet & Arizona Mining Co	Do.
Do	Phelps Dodge Corporation	Do.
Globe	Old Dominion Co	Do.
Hayden	American Smelting & Refining Co	Do.
Miami	International Smelting Co	Do.
Maryland: Baltimore	Baltimore Copper Smelting & Rolling Co	Electrolytic.
Michigan:		
Hancock	Quincy Mining Co	Anodes and lake.
Houghton	Michigan Smelting Co	Do.
Hubbell	Calumet & Hecla Mining Co	Do.
Montana:		
Anaconda	Anaconda Copper Mining Co	Blister.
Butte	East Butte Copper Mining Co	Do.
Great Falls	Anaconda Copper Mining Co	Blister and electrolytic.
Nevada: McGill	Nevada Consolidated Copper Co	Blister.
New Jersey: [a]		
Chrome	United States Metals Refining Co	Blister and electrolytic.
Maurer	American Smelting & Refining Co	Blister, electrolytic, and casting.
Newark	Balbach Smelting & Refining Co	Casting.
Perth Amboy	Raritan Copper Works	Electrolytic and casting.
New York: Laurel Hill	Nichols Copper Co	Blister and electrolytic.
Tennessee:		
Copperhill	Tennessee Copper Co	Blister.
Isabella	Ducktown Sulphur, Copper & Iron Co. (Ltd.)	Do.
Texas: El Paso	American Smelting & Refining Co	Do.
Utah:		
Garfield	Garfield Smelting Co	Do.
International	International Smelting Co	Do.
Virginia: West Norfolk	Norfolk Smelting Co	Do.
Washington: Tacoma	American Smelting & Refining Co	Blister and electrolytic.
British Columbia: Trail	Consolidated Mining & Smelting Co. of Canada	Blister.

[a] This list does not include a smelter in New Jersey, which made blister from material solely of foreign origin.

During the year 30 copper smelting and refining plants treated material from the United States; of these 29 were domestic plants and 1 was foreign.

The figures of production represent the actual smelter recovery. For Michigan it is the sum of furnace-refined copper and copper cast into anodes for electrolytic refining. As to blister copper, the figures represent the fine copper content. Some casting and electrolytic copper is produced direct from ore or matte, and this is included in the smelter production. Metallic and cement copper recovered by leaching is also included in smelter production.

MINE RETURNS.

The figures of mine production are based on reports furnished to the United States Geological Survey by all mines producing copper in 1921. These mines reported 466,190,853 pounds of copper.

The mines and smelters of several of the large copper producers are under the same management, and their production is reported on the same basis. The figures furnished by mines that ship to custom smelters or have only matting furnaces and ship their matte for conversion are likely to show considerable discrepancy from the smelter returns, as the mines may report a considerable quantity that has not yet reached the stage of blister copper by the end of the year and is consequently not included in the smelter production, or material that was reported by the mines in one year may be treated by the smelters in the following year. This discrepancy is more

pronounced if a marked curtailment of production occurs at the beginning or the end of the year, so that there is not the balance of overlap that occurs if the industry is in normal condition throughout the year. Considerable copper is recovered by the smelters from ores that are treated primarily for other metals, the copper content being so low that it is not paid for and consequently is not always reported by the mines.

The difference between the smelter and the refinery production is accounted for entirely by an increase in the stocks of blister copper plus the copper content of bluestone produced and the loss in refining.

Copper produced from domestic ores as reported by mines, smelters, and refineries, 1913 and 1918–1921, in pounds.

Year.	Mine.	Smelter.	Refinery.
1913	1,235,569,727	1,224,484,098	1,236,823,913
1918	1,910,022,841	1,908,533,595	1,882,874,191
1919	1,212,334,041	1,286,419,329	1,433,485,795
1920	1,224,550,151	1,209,061,040	1,182,423,240
1921	466,190,853	505,586,098	609,414,256

PRODUCTION BY STATES.

Sixteen States and one Territory contributed to the smelter production of copper in 1921.

According to smelter returns, the four leading States—Arizona, Michigan, Alaska, and Montana—produced 76 per cent of the total output in 1921, as compared with 82 per cent in 1920; and the eight leading States, including the four named and Utah, New Mexico, California, and Nevada, produced 95 per cent of the total output in 1921.

Copper produced in the United States in 1920 and 1921, according to smelter and mine returns, by States, in pounds.

State.	1920		1921			
			Smelter returns.			
	Smelter returns.	Mine returns.	Rank.	Percentage of total.	Quantity.	Mine returns.
Alaska	66,093,924	70,435,363	3	15	76,808,114	57,011,597
Arizona	552,988,731	558,256,302	1	31	155,165,656	185,034,194
California	11,822,028	12,626,272	7	3	15,906,883	11,743,404
Colorado	4,282,616	4,043,734	10	1	6,592,598	4,153,442
Georgia	3,663	5,780	.....	.....	.....	.....
Idaho	1,922,116	2,538,396	11	.....	1,971,623	1,688,195
Maine	.....	.....	17	.....	3	.....
Michigan	153,483,952	154,695,073	2	20	100,918,001	86,370,028
Missouri	533,368	1,512,539	14	.....	137,591	137,591
Montana	177,743,747	177,059,260	4	10	49,471,206	48,098,730
Nevada	55,580,322	50,559,763	8	3	15,129,116	10,961,491
New Mexico	52,159,751	54,400,691	6	4	18,076,909	14,267,338
Oregon	2,529,311	2,355,276	13	.....	274,934	174,300
Pennsylvania	618,361	405,092	.....	.....	.....	313,302
South Dakota	2,190	.....	.....	.....	.....	.....
Tennessee	16,727,803	16,727,803	9	3	15,084,294	15,084,294
Texas	14,217	14,435	16	.....	587	.....
Utah	110,357,748	116,931,238	5	9	45,831,959	30,891,403
Washington	2,125,586	1,983,134	12	.....	598,658	251,544
Wyoming	24,256	.....	15	.....	9,830	10,000
Undistributed	47,350	.....	.....	1	3,608,136	.....
	1,209,061,040	1,224,550,151	.....	100	505,586,098	466,190,853

Copper produced in the United States, 1845–1921, by States.

[Smelter output.]

State.	Pounds.	Percent.	Rank.
Alaska	675,257,584	2	8
Arizona	8,500,925,933	28	1
California	796,185,053	3	6
Colorado	290,605,186	1	10
Idaho	114,450,615	.....	11
Michigan	6,961,378,104	23	3
Montana	8,061,394,471	27	2
Nevada	957,508,434	3	5
New Mexico	716,203,395	3	7
Oregon	15,549,894	.....	14
Tennessee	[a] 398,553,000	1	9
Utah	2,408,562,961	8	4
Washington	17,695,070	.....	13
Wyoming	31,585,120	.....	12
Other States and unapportioned	161,800,750	1	.....
	30,107,655,570	100	.....

[a] Approximate production.

Arizona, Montana, and Michigan are the three chief copper-producing States. Arizona ranks first, with more than 28 per cent of the entire output of the country; Montana ranks second, with 27 per cent; and Michigan ranks third, with more than 23 per cent. The three leading States have produced 78 per cent of the total. Utah, ranking next in order, has produced about 8 per cent of the total.

Mine production of copper in the principal districts in 1921.

District or region.	State.	Mine output (pounds).	Percentage of total production.	Rank.
Lake Superior	Michigan	86,370,000	19	1
Globe-Miami	Arizona	76,488,000	16	2
Copper River	Alaska	51,231,000	11	3
Butte	Montana	47,958,000	10	4
Bisbee (Warren)	Arizona	37,249,000	8	5
Bingham	Utah	28,011,000	6	6
Jerome	Arizona	26,568,000	6	7
Ajo	....do	20,198,000	4	8
Ducktown	Tennessee	15,084,000	3	9
Plumas County	California	11,583,000	2	10
Morenci-Metcalf	Arizona	11,420,000	2	11
Ely (Robinson)	Nevada	10,283,000	2	12
Ray (Mineral Creek)	Arizona	10,111,000	2	13
Santa Rita (Central)	New Mexico	9,138,000	2	14
Prince William Sound	Alaska	5,277,000	1	15
Burro Mountain	New Mexico	4,496,000	1	16
Lake and Eagle counties	Colorado	2,940,000	1	17
Pioneer	Arizona	2,276,000	.....	18
Tintic	Utah	1,570,000	.....	19
Alder Creek	Idaho	1,089,000	.....	20

As shown in this table, 20 districts in 1921 each produced 1,000,000 pounds or more of copper.

In the following table the statistics for the later years are compiled from reports furnished to the United States Geological Survey by the

producing companies, and those for the earlier years are taken mainly from reports on the several districts by members of the Survey:

Blister copper produced in the principal districts to the end of 1921.

District.	State.	Date production began.	Pounds.	Per cent.	Rank.
Butte	Montana	1868	8,015,008,000	27	1
Lake Superior	Michigan	1845	6,932,173,000	23	2
Bisbee	Arizona	1880	2,825,619,000	9	3
Bingham	Utah	1896	2,065,091,000	7	4
Globe-Miami	Arizona	1881	1,698,305,000	6	5
Morenci-Metcalf	do	1873	1,514,097,000	5	6
Jerome	do	1883	1,341,105,000	4	7
Ely (Robinson)	Nevada	1908	826,666,000	3	8
Santa Rita (Central)	New Mexico	1800	626,783,000	2	9
Ray (Mineral Creek)	Arizona	1911	585,447,000	2	10
Shasta County	California	1897	573,919,000	2	11
Ducktown	Tennessee	1850	398,553,000	1	12
Foothill belt	California	1862	155,045,000	1	13
Tintic	Utah	1880	154,349,000	1	14

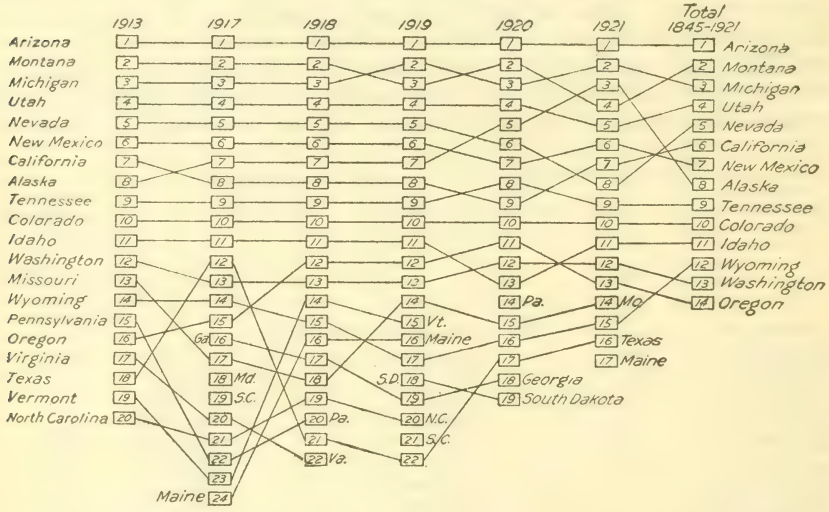

FIGURE 9.—Chart showing rank of States producing copper, 1845–1921. Prepared by Helena M. Meyer.

Fourteen districts in eight States have each contributed in excess of 150,000,000 pounds to the copper output of the country. Five of these districts are in Arizona, 2 each in California and Utah, and 1 each in Montana, Michigan, Nevada, New Mexico, and Tennessee. Two districts stand out prominently. They are the Butte district, Mont., which has produced 26.62 per cent of the output of the country, and the Lake Superior district, Mich., which has produced 23.02 per cent of the total output. Bisbee, Ariz., ranking third, has yielded 9.39 per cent of the total. The 14 districts have yielded 93 per cent of the total output of the United States since 1845.

QUANTITY AND ESTIMATED RECOVERABLE CONTENT OF COPPER-BEARING ORES.

The following tables show the quantity and the estimated recoverable content in copper of the ore produced by the mines of the United States in 1921. The figures are taken from the mines reports in Mineral Resources. The close agreement between the output as reported by the smelters and the recoverable quantity as reported by the mines indicates that the estimated recoverable tenor is very close to the actual recovery. The classification of some of the complex western ores is difficult and more or less arbitrary. Under copper ores are classed not only those which contain 2.5 per cent or more of copper, but those which contain less than this percentage if their principal value is in copper. Under copper-lead and copper-zinc ores are classed complex ores in which copper is a valuable constituent. Considerable copper was reported by the mines from ores mined primarily for other metals, including siliceous gold and silver ores, lead ores, zinc ores, pyritic sulphur ores, and ores concentrated for their content of other metals. No attempt has been made to compile tables showing the quantity and recoverable content of this group of copper-bearing ores, but together with old slags and other materials they yielded a total of 10,057,154 pounds of copper.

Copper produced in the United States in 1921 from ores in which copper constitutes the principal value.

State.	Copper ore (short tons).	Copper in ore.		Gold in ore (fine ounces).	Silver in ore (fine ounces).	Value in gold and silver per ton.
		Pounds.	Percentage.			
Alaska	476,967	56,974,837	5.97	565	544,311	$1.17
Arizona	5,181,177	184,812,780	1.78	21,732	1,241,436	.33
California	306,134	11,599,540	1.89	1,439	175,870	.67
Colorado	22,195	1,164,248	2.62	1,811	382,521	18.92
Idaho	10,322	1,105,511	5.36	1,259	23,987	4.84
Michigan	3,610,648	86,370,028	1.20	.....	310,727	.27
Montana	928,461	46,888,812	2.53	4,733	1,663,472	1.90
Nevada	401,153	10,318,851	1.29	4,747	19,323	.29
New Mexico	533,231	13,637,034	1.28	630	24,489	.07
Oregon	2,398	174,300	3.63	434	1,339	4.30
Tennessee	564,457	15,084,294	1.34	238	98,762	.18
Utah	1,357,857	27,321,481	1.01	14,385	229,556	.39
Washington	1,332	246,017	9.23	25	65,716	49.72
Wyoming	50	10,000	10.00	.....	111	2.22
Total and average	13,396,382	455,707,733	1.70	51,998	4,781,620	.44

Copper ores concentrated, smelted, and leached and copper produced from each class of ore in the United States in 1921.

State.	Ore concentrated.			
	Short tons.	Concentrates produced (short tons).	Copper in concentrates (pounds).	Percentage of copper.
Alaska	448,236	47,571	34,585,960	3.86
Arizona	3,632,342	199,064	94,634,203	1.30
California	306,024	19,830	11,580,827	1.89
Idaho	300	19	8,686	1.45
Michigan	3,610,648	[a] 74,012	[b] 86,370,028	1.20
Montana	881,051	167,609	40,447,426	2.30
Nevada	392,645	41,376	8,824,837	1.12
New Mexico	533,165	40,382	13,633,402	1.28
Oregon	2,398	573	174,300	3.63
Utah	1,113,218	58,068	23,813,053	1.07
Tennessee	102,517	8,897	2,801,200	1.37
Total and average	11,022,544	657,401	316,873,922	1.44

Copper ores concentrated, smelted, and leached and copper produced from each class of ore in the United States in 1921—Continued

State.	Ore leached.[c]			Ore smelted.		
	Short tons.	Copper produced (pounds).	Per centage of copper.	Short tons.	Copper produced (pounds).	Percentage of copper.
Alaska				28,731	22,388,877	38.96
Arizona	931,049	20,207,434	1.09	617,786	69,971,143	5.66
California				110	18,713	8.51
Colorado				22,195	1,164,248	2.62
Idaho				10,022	1,096,825	5.47
Montana				47,410	6,441,386	6.79
Nevada				8,508	1,494,014	8.78
New Mexico				66	3,632	2.75
Tennessee				461,940	12,283,094	1.33
Utah	207,187	742,359	.18	37,452	2,766,069	3.69
Washington				1,332	246,017	9.23
Wyoming				50	10,000	10.00
Total and average	1,138,236	20,949,793	.92	1,235,602	117,884,018	4.77

[a] Includes concentrates from sands.
[b] Includes copper from sands.
[c] Does not include old tailings treated.

Copper produced from copper-lead and copper-zinc ores in the United States in 1921.

State.	Copper-lead and copper-zinc ores (short tons).	Copper in ore (pounds).	Percentage of copper.
Arizona	141	10,248	3.63
Colorado	820	78,448	4.78
Idaho	9,122	125,717	.69
Montana	334	24,388	3.65
Nevada	1,689	27,912	.83
New Mexico	378	49,240	6.51
Utah	1,764	110,013	3.12
Total and average	14,248	425,966	1.49

Copper derived from ores classed as copper-bearing (copper, copper-lead, and copper-zinc ores), and total production of copper from all sources in the United States in 1921.

State.	Ore treated (short tons).	Copper recovered (pounds).	Percentage of copper.	Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds).
Alaska	476,967	56,974,837	5.97	57,011,597
Arizona[a]	5,181,318	184,823,028	1.78	185,034,194
California	306,134	11,599,540	1.89	11,743,404
Colorado[b]	23,015	1,242,696	2.70	4,153,442
Idaho	19,444	1,231,228	3.17	1,688,195
Michigan	3,610,648	86,370,028	1.20	86,370,028
Missouri				137,591
Montana[c]	928,795	46,913,200	2.53	48,098,730
Nevada	402,842	10,346,763	1.28	10,961,491
New Mexico[d]	533,609	13,686,274	1.28	14,267,338
Oregon	2,398	174,300	3.63	174,300
Pennsylvania				313,302
Tennessee	564,457	15,084,294	1.34	15,084,294
Utah	1,359,621	27,431,494	1.01	30,891,403
Washington	1,332	246,017	9.23	251,544
Wyoming	50	10,000	10.00	10,000
Total and average	13,410,630	456,133,699	1.70	466,190,853

[a] A quantity of copper was recovered from old slags and ores not classed as copper ores.
[b] Most of the copper from Colorado is derived from ores classed as siliceous ores and lead ores.
[c] Considerable copper was recovered as precipitates from mine waters and from ores not classed as copper ores.
[d] A quantity of copper was derived from ores classed as lead ores and siliceous ores.

Copper ores produced in the United States, 1916-1921, and average yield in copper, gold, and silver.

Year.	Smelting ores.		Concentrating ores.		Total.				
	Short tons.	Yield in copper (per cent).	Short tons.	Yield in copper (per cent).	Short tons.	Yield in copper (per cent).	Yield per ton in gold ounce.	Yield per ton in silver ounce.	Value per ton in gold and silver.
1916	6,928,010	4.72	50,935,355	1.28	57,863,365	1.70	0.0069	0.424	$0.42
1917	7,438,068	4.39	51,044,626	1.19	58,482,694	1.60	.0058	.347	.49
1918	6,223,674	4.51	53,937,796	1.18	62,289,069	1.51	.0050	.328	.50
1919	3,465,880	4.64	30,769,966	1.35	36,121,622	1.65	.0052	.356	.51
1920	3,200,509	4.89	31,348,340	1.34	36,765,370	1.63	.0047	.331	.46
1921	1,235,602	4.77	11,022,544	1.44	13,396,382	1.70	.0039	.357	.44

The output of copper-bearing ores in 1921 decreased 64 per cent from 1920. Arizona is the largest producer of copper from copper ore, followed by Michigan, Alaska, Montana, Utah, Tennessee, New Mexico, and California. In the output of smelting ore Arizona is first, followed by Tennessee, Montana, Utah, Alaska, Colorado, and Idaho. In the output of concentrating ore Arizona is first, followed by Michigan, Utah, Montana, New Mexico, Alaska, Nevada, and California.

The estimated average recoverable content of copper in copper ore in 1921 was 1.70 per cent, 0.07 per cent higher than in 1920. The average yield from direct smelting ores decreased and that from concentrating ores increased.

Of the principal copper-producing States Alaska showed the highest recoverable content of copper from ore, followed in order by Montana, California, Arizona, Tennessee, Nevada, New Mexico, Michigan, and Utah. Of the States producing smelter ore in large quantity Alaska had the highest recoverable content, followed by Montana, Arizona, Idaho, Utah, Colorado, and Tennessee. Of the States producing concentrating ores in large quantity Alaska had the highest recoverable content, followed by Montana, California, Arizona, New Mexico, Michigan, Nevada, and Utah.

The average value of the gold and silver recovered from copper ores in 1921 was 44 cents per ton. Its ratio to the value of the copper was a little less than in the four preceding years. Among the principal copper-producing States Montana was first in the average yield of gold and silver, followed by Alaska, California, Utah, Arizona, Michigan, Tennessee, and New Mexico

REVIEW BY COMPANIES AND STATES.

SCOPE OF DISCUSSION.

In the following pages a brief statement of the conditions affecting production in the principal copper districts of the country is presented, and the tenor of the ore from each district is given, so far as it does not disclose the production of those individual companies whose figures of output have not already been published in their annual reports or elsewhere. More detailed information on the mining operations of the districts is given in the reports on mine production listed in the prefatory note.

Figures of metal output, ore reserves, metal content, and recovery in treatment of individual companies given in this report, unless otherwise stated, are quoted from the official reports of the companies.

The report for 1915 contains a map showing the location of the copper-producing districts and the metallurgic plants and also a brief discussion of the geologic occurrence of the ores in the different districts. Copies of that report may be obtained on application to the Director of the United States Geological Survey.

The statistics covering the operations of the American Smelting & Refining Co. given below cover operations in Mexico and South America, except where indicated, as well as in the United States:

Metallic production of the American Smelting & Refining Co., 1914, 1920, and 1921.

	1914	1920	1921
Gold.....ounces..	2,540,911	1,849,048	1,780,205
Silver.....do....	77,604,483	77,732,911	75,354,443
Platinum and palladium.....do....	1,664	936	863
Lead.....short tons..	316,591	205,249	207,612
Copper.....pounds..	529,686,000	590,850,000	348,888,000
Spelter.....do....	15,748,000	44,106,253	14,628,614
Nickel.....do....	356,187	375,167	120,080
Tin.....do....	.....	18,511,160	11,915,954
Sulphuric acid.....do....	24,296,000	51,688,000	9,952,000
Arsenic.....do....	6,184,000	17,695,266	5,155,522
Copper sulphate.....do....	6,798,000	3,618,172	2,237,471
By-product metals.....do....	1,678,228	1,549,426	3,232,488
Sulphur dioxide.....do....	.....	8,154,734	154,794
Operating statistics.			
Number of men employed exclusive of Mexico and South America.....	12,179	13,330	7,605
Total wages and salaries, exclusive of Mexico and South America.....	$10,212,591	$20,164,508	$11,440,480
Average wage per 8-hour day.....	$2.33	$5.04	$4.17
Charge smelted.....short tons..	4,171,258	4,050,751	2,583,142
Bullion refined.....do....	588,718	505,535	357,062
Coal used.....do....	544,619	499,713	302,924
Coke used.....do....	447,761	394,014	263,384
Fuel oil used.....barrels..	976,528	1,294,299	1,432,085
Gas used.....cubic feet..	7,430,300	2,674,177,277	837,012,321
Ore mined.....short tons..	1,266,702	2,311,946	2,205,537
Coal mined.....do....	257,942	509,424	360,952
Coke produced.....do....	129,650	181,664	100,860

ALASKA.

The production of blister copper from Alaska in 1921 was 76,808,114 pounds, as compared with 66,093,924 pounds in 1920. The mine production of copper in 1921 was 57,011,597 pounds

Alaska began to produce copper in notable quantity about 1903, and since that time it has been a steady contributor. Its total production of blister copper to the end of 1921 is 675,257,584 pounds. The output in 1921 came from the Ketchikan, Prince William Sound, and Copper River districts.

Ketchikan district.—The copper mines in the Ketchikan district yielded 2,107 tons of ore, from which 468,202 pounds of copper was produced.

Prince William Sound district.—The production of copper in the Prince William Sound district decreased from 13,767,548 pounds in 1920 to 5,276,680 pounds in 1921. The ores of the district were

shipped to the Tacoma and Anyox smelters. Besides the copper, the 168,058 tons of ore treated yielded 38,544 ounces of silver.

The Beatson mine of the Kennecott Copper Corporation, operating at 50 per cent capacity until April 1 and approximately at 25 per cent capacity during the remainder of the year, produced 168,058 tons of ore containing 1.83 per cent of copper representing 3,075.46 tons. A total of 168,108 tons of ore was milled and produced 17,207 tons of concentrates assaying 15.33 per cent copper. The recovery was 85.92 per cent, compared with 82.85 per cent in 1920.

Copper River district.—The Bonanza and Jumbo mines of the Kennecott Copper Corporation were the largest producers in the Copper River district. They produced 229,809 tons of ore containing 7.66 per cent of copper compared with 223,009 tons containing 9.04 per cent of copper in 1920. The 212,723 tons of ore milled, assaying 5.62 per cent of copper, yielded 18,571.4 tons of concentrates, assaying 49.01 per cent of copper. The mill recovery was 77.82 per cent, compared with 82.29 per cent in 1920. The company states that the decrease in recovery was due largely to a more careful preliminary separation of high-grade from milling ores and to the generally lower grade of ore treated during the year. The cost of milling was 71.9 cents a ton, compared with 76 cents in 1920. The leaching plant treated 192,551 tons of mill tailings, assaying 0.95 per cent of carbonate of copper, from which was recovered 2,808,000 pounds of copper in the form of precipitates, assaying 74.63 per cent. The leaching plant operated only 11 months, a shutdown being necessitated by a remodeling of the piping sytem. This loss of time, coupled with the lower milling recovery mentioned above, reduced the total average milling recovery for 1921 to 86.07 per cent, compared with 90.10 per cent in 1920.

The total production from the Copper River and Beatson properties was 40,271,729 pounds of deliverable refined copper and 390,012 ounces of returnable silver. Profit on metal sold by the Kennecott Copper Corporation amounted to $1,293,733 and total profits, including dividends on stock held by the company, amounted to $3,779,392.

ARIZONA.

Inclusive of 1921, Arizona has made a recorded production of 8,500,925,933 pounds of copper, which represents 28 per cent of the total production of the United States since 1845. In 1921 the production was 155,165,656 pounds, or 31 per cent of the United States total for the year compared with 552,988,731 pounds, or 46 per cent in 1920.

Bisbee district.—The Copper Queen branch of the Phelps Dodge Corporation was, as usual, the largest producer in the Bisbee district, with an output of 30,610,173 pounds of copper, compared with 71,443,396 pounds in 1920. It is interesting to note that the proportion of the foreign to the total sales of the Phelps Dodge Corporation increased from 12 to 31 per cent, owing largely, according to the corporation, to a more active demand for copper in Germany and the Far East. A total of 134,999,025 pounds of copper was sold and delivered to buyers at an average price of 12.959 cents a pound net cash f. o. b. New York. In addition to this, 12,287,005 pounds

of copper taken over with the properties of the Arizona Copper Co. (Ltd.), was sold for the Phelps Dodge Corporation by the United Metals Selling Co.

Copper produced in Bisbee district, Ariz., 1916–1921.

Year.	Pounds.	Average yield in copper (per cent).	Value in gold and silver per ton.
1917	167,600,000	5.0	1.56
1918	160,456,000	4.9	1.62
1919	122,311,000	4.87	2.21
1920	118,448,000	4.06	1.81
1921	37,249,000	4.81	3.00

The production of the Copper Queen branch of the Phelps Dodge Corporation, as summarized in the Company's report, is as follows:

Metals produced by Copper Queen branch of Phelps Dodge Corporation, 1921.

Production of mines.

	Ore, dry weight.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Ounces.*	*Ounces.*	*Pounds.*	*Pounds.*
Underground—copper	143,241	2,326	197,286	18,696,487	.....
Underground—lead	15,807	960	214,201	40,472	4,916,418
Total underground	159,048	3,286	411,487	18,736,959	4,916,418
Steam shovel—high grade	16,654	164	9,923	1,854,137	.....
Steam shovel—low grade	339,496	1,200	73,704	9,682,928	.....
Total steam shovel	356,150	1,364	83,627	11,537,065	.....
Precipitates	434	.....	65	336,149	.....
Total production	515,632	4,650	495,179	30,610,173	4,916,418

Production of reduction works.

	Ore, dry weight.	Gold.	Silver.	Copper.
	Short tons.	*Ounces.*	*Ounces.*	*Pounds.*
Copper Queen branch	122,029	2,248	132,467	14,920,779
Burro Mountain branch	19,283	91	16,969	4,683,610
Moctezuma Copper Co.	32,863	945	120,360	6,998,174
Calumet and Arizona Co. exchange ore	16,387	862	28,643	864,273
All other	7,651	484	144,196	124,338
	198,213	4,630	442,635	27,591,174
Total, 1920	787,985	17,269	1,643,115	95,182,165
Total, 1919	746,107	18,440	1,504,387	97,640,857

Production at the Copper Queen branch of the Phelps Dodge Corporation was maintained at a reduced rate until April, 1921, when it was entirely discontinued. Underground development was continued during the remainder of the year and was reported to be very satisfactory. The organization has been maintained with a material proportion of the underground forces, so that the production of ore could be resumed at short notice.

Metals produced by Copper Queen Consolidated Mining Co., 1916–1921.

Year.	Ore.	Copper.	Silver.	Gold.	Lead.
	Short tons.	*Pounds.*	*Ounces.*	*Ounces.*	*Pounds.*
1916	951,978	102,685,722	1,096,136	24,030	9,421,562
1917	800,970	93,618,409	828,665	19,156	6,870,128
1918	771,063	90,988,156	558,433	16,409	1,234,497
1919	606,386	68,614,002	492,326	10,813	9,372
1920	832,172	71,443,396	486,698	8,846	243,836
1921	515,632	30,610,173	495,179	4,650	4,916,418

The Limestone mines of the Copper Queen branch produced 16,352,590 pounds of copper from January 1 to April 12, when operations were discontinued. From then until the end of the year 2,258,585 pounds of copper was produced from prospect and development work.

During the period of operation 702,009 solid yards of waste was removed from Sacramento Hill, and 29,346 tons of ore averaging 4.67 per cent of copper and 326,804 tons of ore averaging 1.34 per cent of copper were produced.

Metals produced by Calumet & Arizona Mining Co., 1916–1921.

Year.	Ore smelted.	Copper produced.	Copper recovered.	Gold.	Silver.	Dividends.
	Short tons.	*Pounds.*	*Per cent.*	*Ounces.*	*Ounces.*	
1916	845,286	70,702,028	4.17	31,673	1,267,734	$5,777,296
1917	.....	59,131,512	.....	27,947	906,038	6,424,762
1918	.....	50,909,373	.....	31,308	906,210	5,140,062
1919	.....	44,991,107	.....	28,530	995,366	1,927,563
1920	.....	42,430,847	.....	32,520	932,489	2,570,084
1921	.....	17,855,613	.....	12,365	419,647	1,285,043

Production was suspended by the Calumet & Arizona Mining Co. on April 18, 1921. At that time the company had 21,485,311 pounds of copper in stock, exclusive of the 11,000,000 pounds pledged to the Copper Export Association. This quantity was reduced to 5,881,995 pounds on hand at the end of the year. Of the 217,069 tons of ore produced, 181,735 tons was shipped to the Calumet & Arizona smelter at Douglas, 19,495 tons of exchange ore was shipped to the Copper Queen smelter at Douglas, 12,689 tons of low-grade high-sulphur copper ore was shipped to the New Cornelia Copper Co. at Ajo, and 3,150 tons of high-sulphur low-copper ore was shipped to the Old Dominion Copper Co., at Globe.

The year 1921 was the only year since the Calumet & Arizona Mining Co. began to produce copper in which its accounts showed a deficit.

The Shattuck Arizona Copper Co. discontinued operations in November, 1920, and owing to the continued low selling price of copper and the inflated costs of production did not resume in 1921. A vigorous campaign of development was carried on until July 13, 1921, and according to the company an excellent body of new ore was discovered.

Metals produced by Shattuck Arizona Copper Co., 1916–1921.

Year.	Copper.	Silver.	Gold.	Lead.	Copper recovered.	Dividends.
	Pounds.	*Ounces.*	*Ounces.*	*Pounds.*	*Per cent.*	
1916	18,161,763	314,918	4,721	3,413,445	5.83	$1,662,500
1917	11,935,317	154,344	1,542	2,010,145	4.57	612,500
1918	9,081,959	161,230	1,220	2,420,690	4.83	437,500
1919	2,111,841	89,724	300	4,432,655	4.74	[a] 262,500
1920	2,374,148	73,718	575	8,254,603	6.19	.....
1921 [b]	287,928	12,093	29	.....	7.94	.....

[a] Capital distribution through 1921 to the amount of $1,487,500.
[b] Result of development work only. No productive operations carried on.

Globe-Miami district.—Inclusive of 1921, the Globe-Miami district has produced 1,698,305,000 pounds of copper, which represents 6 per cent of the total output of the United States since 1845. The district ranks fifth in the country and second in the State. The Miami part of the district did not make a notable output until 1911.

Copper produced in Globe-Miami district, Ariz., 1916–1921.

Year.	Copper.	Yield of ore in copper.	Year.	Copper.	Yield of ore in copper.
	Pounds.	*Per cent.*		*Pounds.*	*Per cent.*
1916	220,000,000	1.43	1919	171,106,000	1.36
1917	169,490,000	1.42	1920	176,215,000	1.20
1918	201,806,000	1.31	1921	76,488,000	1.33

The chief producers of the district are the Inspiration Consolidated Copper Co., the Miami Copper Co., the Old Dominion Co., and the Arizona Commercial Co.

Ore produced by Old Dominion Co., 1921.

	Short tons.	Percentage of copper.
Smelting ore	19,967	6.80
Concentrating ore	40,672	4.56
Converting ore	1,114	5.72
	61,753	5.31

Metals produced by Old Dominion Co., 1916–1921.

Year.	Ore.	Copper.	Gold.	Silver.	Average grade of ore in copper.	Cost per pound of copper.	Dividends.
	Short tons.	*Pounds.*	*Ounces.*	*Ounces.*	*Per cent.*	*Cents.*	
1916	152,059	17,654,643	1,240	60,688	5.88	11.69	$1,944,000
1917 [a]	199,888	32,365,795	3,897	165,703	4.97	.....	2,376,262
1918	230,451	33,378,158	5,071	184,982	4.52	.....	1,188,284
1919	253,686	28,166,396	5,756	137,071	4.28	.....	.....
1920	249,111	22,854,452	3,484	181,010	4.79	.....	.....
1921	61,753	7,389,648	1,187	71,155	5.31	.....	.....

[a] Includes custom ores.

The generally poor business conditions prevailing in the copper industry caused the Old Dominion Co. to cease production on April 12. On account of its great economy, a new Diesel engine was installed after the mine was shut down, to replace steam equipment.

The Miami Copper Co. operated at an average of about 80 per cent of normal capacity during 1921.

Copper produced by Miami Copper Co., 1916–1921.

Year.	Ore.	Copper content.	Mill extraction.	Refined copper.	Cost of copper per pound.	Dividends.
	Short tons.	*Per cent.*	*Per cent.*	*Pounds.*	*Cents.*	
1916	1,842,017	2.07	73.88	53,518,331	9.52	$4,295,905
1917	1,640,206	2.03	69.25	43,863,669	12.51	6,537,247
1918	2,132,941	2.026	71.15	58,407,563	14.833	3,362,013
1919	1,698,446	2.04	82.38	54,221,638	15.812	1,867,785
1920	1,801,958	1.968	82.48	55,581,328	11.898	1,494,228
1921	1,868,757	1.758	85.37	53,311,941	11.284	1,494,228

Milling operations of Miami Copper Co., 1921.

Ore milled	short tons	1,868,757
Copper in ore	per cent	1.758
Concentrates produced	short tons	73,123
Copper in concentrates	per cent	38.372
	pounds	56,117,827
Copper recovered per ton of ore	do	30.03
Mill extraction	per cent	85.37

Cost of copper in concentrates f. o. b. cars at Miami, Ariz., 1921.

	Per ton of ore.	Per pound of copper.
Mining	$1.14905	$0.04028
Milling	.70464	.02470
General	.38384	.01347
	2.23753	.07845

Ore reserves of Miami Copper Co., January 1, 1921.

	Short tons.	Percentage of copper.
High-grade sulphide ore	8,899,834	2.26
Low-grade sulphide ore	36,000,000	1.06
Mixed sulphide and oxide ore	6,000,000	2.00
	50,899,834	.....

The metallurgical efficiency of the mill during the year was the highest since the beginning of operations in 1911, copper extraction being 85.367 per cent and the sulphide copper in the mill general tailing being 0.132 per cent. The cost per ton of ore treated was reduced 28 cents from the cost in 1920, but the reduction amounted

to only about half a cent per pound of copper produced, owing to a slightly lower yield per ton of ore.

Operations were continued on a smaller scale by the Inspiration Consolidated Copper Co. during the first quarter of 1921 and were discontinued entirely on March 31. Ore was mined at the rate of 19.1 tons per man shift for all labor chargeable to the mining division, as compared with 19.61 tons for 1920. Development work was carried on during the entire year, and work was started on opening up the old Montgomery workings of the Warrior group, from which 1,932 tons of ore, averaging 3.72 per cent of copper, was extracted. The cost of fine copper produced during the period of operation, including depreciation but excluding depletion, Federal taxes, and shut down expenses, amounted to 15.208 cents a pound. During 1921 the company acquired certain properties of the Porphyry Copper Co. and the Porphyry Consolidated Copper Co., which aggregated 561.567 acres and adjoin the property of the Inspiration Consolidated Copper Co.

Mill statistics, Inspiration Consolidated Copper Co., 1921.

Total ore milled	dry tons	912,280
Ore milled per day	do	9,844
Average number of sections running		10.2
Average rate per section	tons	968
Screen analysis of feed (on 48 mesh)	per cent	4.3
Assay mill feed	per cent of copper	1.123
Copper in feed, oxidized	per cent	.177
Copper assay of general tailings	do	.289
Copper in general tailings, oxidized	do	.174
Copper in general concentrates, smelter assay	do	28.235
Copper in flotation concentrates	do	34.47
Copper in table concentrates	do	10.21
Moisture in general concentrates	do	16.8
Ratio of concentration		33.4
Recovery of copper (calculated from smelter assays):		
Assays only	per cent	75.03
Assays and weights of concentrates and ore	do	75.32
Assays and weights of concentrates and tailings	do	75.13
Assays and weights of ore and tailings	do	75.06
Recovery of copper sulphides	do	88.22
Water used per ton of ore	gallons	536
Power used per ton of ore milled:		
Coarse crushing	kilowatt-hours	0.54
Fine grinding and concentrating	do	10.56
Blowers for flotation air	do	2.13
Filtering and reclaiming water	do	.93
Lighting	do	.21
		14.37
Steel balls consumed per ton of ore milled	pounds	1.88
Flotation oil consumed per ton of ore milled:		
Coal tar	do	1.192
Other oils	do	.173
		1.365

Operations at the Iron Cap mine and mill were discontinued February 15.

Metallic production of the Iron Cap Copper Co., 1919–1921.

	1919	1920	1921
Ore (dry weight)..short tons..	64,540	91,326	4,424
Silver recovered and sold..ounces..	104,458	113,323	4,002
Copper recovered..pounds..	7,156,270	8,235,670	385,548
Average price received:			
Per ounce silver	$1.104	$1.083	$1.015
Per pound copper	.18918	.17444	.12580

Result of mill operation of the Iron Cap Copper Co., 1921.

Ore milled (dry)..short tons..		4,424.3
Average assay of feed	per cent of copper	4.924
	ounces of silver per ton	1.073
Copper contained in ore..pounds..		435,734
Silver contained in ore..ounces..		4,873
Concentrates produced (dry)..short tons..		776
Average assay of concentrates	per cent of copper	29.44
	ounces of silver per ton	6.212
Copper contained in concentrates..pounds..		405,962
Silver contained in concentrates..ounces..		4,447
Tailings rejected (dry)..short tons..		3,647
Average assay of tailings	per cent of copper	.408
	ounces of silver per ton	.117
Copper contained in tailings..pounds..		29,772
Silver contained in tailings..ounces..		426
Recovery of copper..per cent..		93.167
Recovery of silver..do....		91.25
Operating cost per dry short ton		$2.592

No ore was mined at the Copper Hill and Eureka mines of the Arizona Commercial Mining Co. in 1921. The total production from ores on hand at the beginning of the year is given below.

Copper produced by the Arizona Commercial Mining Co., 1919–1921.

Year.	Refined copper.	Gold.	Silver.
	Pounds.	*Ounces.*	*Ounces.*
1919	7,280,861	1,310	16,918
1920	7,913,836	1,722	31,028
1921	572,616	163	3,001

Morenci-Metcalf district.—Inclusive of 1921 the Morenci-Metcalf district has produced a total of 1,514,097,000 pounds, or 5 per cent of the total output of the country since 1845. In total production it ranks sixth among the copper districts of the country, and for 1921 it ranked eleventh.

Copper produced in Morenci-Metcalf district, 1916–1921.

Year.	Quantity.	Average yield of copper from ore.
	Pounds.	*Per cent.*
1916	75,977,000	1.89
1917	53,000,000	1.85
1918	71,867,000	1.71
1919	44,868,000	1.72
1920	35,746,000	1.73
1921	11,420,000	1.47

The Morenci branch of the Phelps Dodge Corporation and the Arizona Copper Co. are the principal producers in the Morenci-Metcalf district. The Morenci branch of the Phelps Dodge Corporation, however, has produced no copper since 1919. During 1921 the Phelps Dodge Corporation completed the purchase of the Arizona Copper Co.'s property, which is adjacent to the Morenci branch, and the two properties have now been consolidated.

Copper produced by Morenci branch of Phelps Dodge Corporation, 1911–1919.

Year.	Ore treated (short tons).	Copper produced.	
		Pounds.	Per cent.
1916	474,808	17,541,258	1.85
1917	333,263	13,202,201	1.98
1918	480,407	17,130,209	2.32
1919	253,208	11,414,031	2.25

Production was maintained by the Arizona Copper Co. until May 31 at the rate of 1,150 tons in January, and approximately 1,000 tons a month thereafter. The results obtained at the experimental mill in treating run-of-mine ores going to No. 6 mill and intermediate tailings products from the big mill confirmed the conclusion reached from work previously done, namely, that by changing the flow sheet of the big mill to that of the experimental mill an increased recovery of 7 to 10 per cent can be made. The essential change required is to regrind the present flotation tailings to 65 mesh and give them a second treatment by flotation, instead of treating them on vanners and tables only, the present practice. The work of extracting ore from the fire zone of the Coronado mine was rushed even after May 31, with a view of removing all the ore endangered by the fire. This ore has been extracted at the rate of 8,000 to 10,000 tons a month and has been treated at the same rate by the experimental mill. It has averaged 1.91 per cent of copper with 0.27 per cent of oxide, and in June, 1921, the mill extracted 86.37 per cent of the total copper and 94.54 per cent of the sulphide of copper contents.

Copper produced by Arizona Copper Co., 1916–1921.

Year ending Sept. 30.	Ore treated.	Copper produced.	Average yield.
	Short tons.	*Pounds.*	*Per cent.*
1916	905,486	34,100,000	1.803
1917	1,178,087	42,482,000	1.830
1918	1,095,568	40,442,000	1.754
1919	1,147,659	36,474,000	1.611
1920	1,046,331	35,692,000	1.642
1921 [a]	573,397	18,550,000	1.701

[a] Figures are for 8 months ending May 31, 1921, when plant was shut down.

Jerome district.—To the end of 1921 the Jerome district has produced 1,341,105,000 pounds of copper, or 4 per cent of the total output of the country since 1845. In total output it stands seventh among the copper districts of the country, and in production for 1921

it ranks seventh. The principal producers of the district are the United Verde Copper Co. and the United Verde Extension Mining Co.

Copper produced in the Jerome district, Ariz., 1916–1921.

	Pounds.		Pounds.
1916	102,000,000	1919	72,333,000
1917	145,900,000	1920	107,084,000
1918	133,781,000	1921	26,568,000

The United Verde Extension Mining Co. discontinued production on May 1; up to that time it had smelted 53,643 dry tons of copper. The ore developed above the 1,500-foot level amounted to 1,102,000 tons, averaging 11.75 per cent of copper and 0.023 ounce of gold and 2.22 ounces of silver to the ton.

The cost of producing copper, exclusive of depreciation, reserve to return capital (depletion), and taxes, was as follows:

Mining	cents per pound	5.90
Smelting	do	3.17
Freight on ore	do	.22
Freight on bullion, refining, selling	do	3.55
Other expenses	do	.62
		13.46

Copper produced by the United Verde Extension Mining Co., 1918–1921.

Year.	Ore treated.	Copper produced.	Silver.	Gold.
	Short tons.	*Pounds.*	*Ounces.*	*Ounces.*
1918	133,535	55,491,077	503,739	3,046
1919	93,325	28,860,615	272,855	3,169
1920	161,617	41,942,700	359,370	5,530
1921	53,643	12,498,005	112,864	2,328

At the end of the year 6,955,942 pounds of copper were held in stock.

Ray or Mineral Creek district.—To the end of 1921 the Ray or Mineral Creek district has produced 585,447,000 pounds of copper, or 2 per cent of the total output of the country since 1845. In total output it stands tenth, and in production for 1921 it ranks thirteenth.

The property of the Ray Consolidated Copper Co. was operated at a rate of slightly less than 40 per cent of its normal capacity during the first quarter of 1921, and production was entirely suspended the first week in April. During the period of production an operating loss of $305,525.38, including credit for the miscellaneous earnings, was sustained. The loss to surplus for the year was further increased by costs and charges, less credit for miscellaneous income earned and applied to the reduction of expenses during the shutdown, making a net loss to surplus of $1,598,318.62 for the year.

Exploration on the third level has disclosed substantial quantities of commercial ore in extension of the main ore body, according to the company's report, but the development work has not been sufficiently advanced to permit an accurate measurement of the additional ore. The reserves calculated by deducting the ore mined during the year from the reserves reported at the end of the previous year amount to 82,652,220 tons. The mining cost for the year was $1.31 per ton exclusive of depreciation, compared with $1.73 for 1920.

Copper produced by Ray Consolidated Mining Co., 1916–1921.

Year.	Ore milled.	Copper content.	Mill recovery.	Refined copper.	Cost per pound.[a]	Dividends and capital distributions.
	Short tons.	*Per cent.*	*Per cent.*	*Pounds.*	*Cents.*	
1916	3,332,340	1.607	70.20	74,983,540	10.267	$4,337,955
1917	3,560,900	1.635	74.53	88,582,649	12.229	6,624,151
1918	3,411,000	1.613	74.92	83,599,160	17.695	5,125,831
1919	1,621,600	1.814	79.45	46,011,371	15.62	3,154,358
1920	1,706,928	1.720	81.98	47,062,030	16.144	1,577,179
1921	406,172	1.646	77.82	10,110,131	16.41	.....

[a] Does not include value received for gold and silver or miscellaneous income.

Ajo district.—During 1921 the Ajo district produced 20,198,000 pounds of copper, or 4 per cent of the total production for the United States. In 1921 the district ranked eighth among the copper-producing districts in the United States.

The New Cornelia Copper Co. operated during the first quarter of the year at a production rate of approximately 2,000,000 pounds a month. Production was further curtailed on March 28 to about 1,500,000 pounds a month. The great expense and delay that would have been involved in bringing the solutions up to normal, when the conditions warranted increased production, prevented a complete shutdown of the leaching plant. At the reduced rate of production it was possible to operate economically, and owing to the small production it was possible to more than double the usual time of leaching and in consequence to decrease the strength of acid in the leaching solution, which caused less impurities to go into solution, and thus cut down the acid consumption to such a degree that very little new acid had to be added. These changes in practice contributed in bringing about a low operating cost. The estimated reserves of carbonate ore on December 31, 1921, were 7,532,175 tons, containing 1.48 per cent of copper.

Copper produced by the New Cornelia Copper Co. in 1920 and 1921, in pounds.

	1920	1921
Electrolytic copper	37,331,586	19,993,758
Copper in cement copper shipped	2,113,985	169,035
Copper in ore shipped	249,353	35,589
Copper in concentrates shipped	409,569	.....
	40,104,493	20,198,382

Pioneer district.—The Pioneer district in Pinal County produced 2,276,000 pounds of copper in 1921, as compared with 9,299,000 pounds in 1920. The Magma Copper Co. is the largest producer in the district.

Copper ore mined and treated and milling results of the Magma Copper Co., 1921.

	Ore.	Copper.	Silver.	Gold.
	Short tons.	*Per cent.*	*Ounces.*	*Ounce.*
Total ore mined	21,445.170	5.2494	3.1492	0.03818
Hand-sorted crude product shipped direct to smelter	2,238.255	16.4511	7.7389	.09044
Mill heads	19,206.915	3.9441	2.6143	.03209
Concentrates produced	6,129.546	11.5967	7.4426	.10056
Average assay of mill tailings		.3572	.3513	Trace.

The mill recovery was 93.834 per cent of the total copper in the mill heads. The total copper recovered, including ore obtained by hand sorting, was 95.854 per cent of the copper content of the run of mine ore. The net production, deducting all smelting and refining losses, was 2,028,889 pounds of copper, 59,794.48 ounces of silver, and 818.88 ounces of gold.

Copper shipments of Magma Copper Co. from beginning of operations to end of 1921.

	Ore.	Copper.	Silver.	Gold.
	Short tons.	*Per cent.*	*Ounces.*	*Ounce.*
Copper concentrates	165,590.8606	11.6815	11.2348	0.12188
Crude sulphides	76,982.5580	16.5873	14.6547	.09903
Crude carbonate	4,433.6240	8.0140	5.2660	.05500
	247,007.0426	13.1446	12.1935	.11356

The total production from the beginning of operations to the end of 1921 has been 64,936,585 pounds of coppper, 3,011,891.55 ounces of silver, and 28,050.084 ounces of gold.

Estimated ore reserves of Magma Copper Co. at the end of 1921.

	Ore.	Gold per ton.	Silver per ton.	Copper.
	Short tons.	*Ounce.*	*Ounces.*	*Per cent.*
Reasonably assured copper sulphide ore	1,505,000	0.025	3.0	5.6

CALIFORNIA.

In 1921 California produced 15,906,883 pounds of blister copper, compared with 11,822,028 pounds in 1920. To the end of 1921 California has produced about 796,185,053 pounds of copper, or 3 per cent of the output of the country since 1845. In 1921 the output was 3 per cent of the total for the United States. In total output the State ranks sixth among the copper producers of the country and for 1921 is ranked seventh.

The copper has been derived chiefly from ores mined in the Shasta, Foothill, and Plumas districts, although numerous other districts have at various times, particularly in recent years, contributed some copper.

Shasta district.—The total production in the Shasta district, inclusive of the year 1921, was 573,919,000 pounds, or about 2 per cent of the total in the United States.

Copper produced in Shasta County district, Calif., 1916–1921.

Year.	Pounds.	Average yield of copper (per cent).	Gold and silver per ton.
1916	39,700,000	2.62	$2.59
1917	26,650,000	2.75	1.00
1918	25,030,000	2.76	1.52
1919	7,626,000	3.91	2.30
1920	514,000	3.35	6.37
1921	100,000	1.67	1.58

The mines of the Mountain Copper Co. were closed throughout 1921 owing to the general depression in the copper industry. The smelter is in a position to commence operations on 30 days' notice.

Foothill district.—The total production in the Foothill district, including that of 1920, has been about 155,045,000 pounds of copper.

Copper produced in Foothill district, Calif., 1916–1921.

Year.	Pounds.	Average yield (per cent).	Year.	Pounds.	Average yield (per cent).
1916	6,460,000	3.07	1919	2,048,000	1.69
1917	8,000,000	4.18	1920	2,201,000	.57
1918	6,937,000	2.07	1921		

Plumas district.—The production of copper in the Plumas district in 1921 was 11,583,000 pounds, as compared with 9,579,000 pounds in 1920. The Engels Copper Mining Co. is by far the largest producer in the district, with an output in 1921 of 11,500,993 pounds of copper, 168,699.18 ounces of silver, and 1,422.691 ounces of gold.

Cost of producing copper by Engels Copper Mining Co., 1921.

		Total.	Per pound of copper.
			Cents.
Ore on cars at Engels		$1,088,555.34	9.46
Freight and smelting charges	$622,103.00		
Credit value of gold and silver recovered	194,735.71		
		427,367.29	3.72
Operating and marketing cost		1,515,922.63	13.18
Cost of depreciation and insurance		173,656.37	1.51
Net cost		1,689,579.00	14.69

Compared with 1920, operating cost showed a reduction of 3.49 cents per pound of copper, a total of $401,385 if applied to the 1921 production.

Operations at Superior mill, 1921.

Ore milled	short tons	306,024
Average heads	per cent	2.2243
Average tails	do	.3681
Actual extraction	do	.84.480
Concentrates produced	pounds	39,659,858
Average content of concentrates	per cent	29.00
Copper produced	pounds	11,500,993
Silver produced	ounces	168,699.18
Gold produced	do	1,422.691

Ore reserves of Engels and Superior mines, December 31, 1921, in short tons

Engels mine		
Blocked ore:		
In place	1,303,935	
Broken ore in stopes	311,825	
		1,615,760
Probable ore		670,800
		2,286,560
Superior mine.		
Blocked ore:		
In place	676,743	
Broken ore in stopes	126,815	
		803,558
Probable ore		252,000
		1,055,558
Grand total		3,342,118

The Engels Copper Mining Co., owing to a favorable contract with the Garfield Smelting Co., was able to operate throughout 1921. The company reports the following results obtained by continued operation:

A. Increase of ore reserves: As shown in Mr. Kinzie's report, actual ore reserves have been increased from 2,271,290 tons to 3,342,118 tons, or over 47 per cent, after deducting total ore milled.

B. Heavy shutdown costs, with consequent depreciation and disorganization, have been avoided, which as already stated would have more than equaled the value of the ore milled plus operating loss.

C. Improved mine conditions, with the completion of the No. 6 stopes and the opening of the No. 7 level as detailed in Mr. Kinzie's report, are well advanced. None of this work could have been done, as the cost of storing and rehandling the ore therefrom would have been too excessive.

D. Construction of the No. 10 adit is well under way, being at this date over 25 per cent completed. As before stated, this tunnel will open large reserves in depth, increase mill output, and reduce costs when completed within the next 18 months.

E. Marked improvement in efficiency of crew has been attained by weeding out incompetent men.

F. Reduction of smelter rates, saving us at least $5,000 per month when copper is under 15 cents per pound, could not have been secured had we shut down.

G. Improved mill results through continued operation and research work.

H. Operating costs reduced 3.49 cents per pound of copper, or over $400,000 per annum compared with results for 1920.

I. Tailings disposal problem completely and effectually solved by flume and reservoir construction during the year.

J. Organization improved and held intact. The entire plant is in excellent physical condition, and ready to increase output and take advantage of better price of copper when it arrives, while the other mines spend several months in getting ready to resume operations.

COLORADO.

The production of blister copper in Colorado increased from 4,282,616 pounds in 1920 to 6,592,598 pounds, or a little more than 1 per cent of the total production of the United States in 1921. The State has no important district, now producing, in which copper is the principal valuable metal, but it ranked tenth among the copper-producing States in 1921 and also tenth in total production of the United States since 1845, with a production of 290,605,186 pounds of copper out of a total of 30,107,655,570 pounds.

The copper has been derived mainly from the treatment of mixed ores in which copper was a minor constituent, including lead-silver

ores and pyritic ores rich in gold and silver. Leadville and the San Juan-Ouray region have been the greatest producers of copper. Much of the output is recovered as matte in lead furnaces.

IDAHO.

In 1921 Idaho produced 1,971,623 pounds of blister copper, an increase of 49,507 pounds over the production in 1920. Inclusive of 1921, Idaho has made a total production of 114,450,615 pounds since 1845.

MICHIGAN.

The total production of refined copper in Michigan from 1845 through 1921 was 6,961,378,104 pounds, or 23 per cent of the total production for the United States, Michigan thus ranking third among the copper-producing States. The production for 1921 was 100,918,001 pounds. The Champion Copper Co. (a subsidiary of the Copper Range Co.) produced the largest quantity of copper in the Lake Superior district in 1921, followed in order by the Quincy Mining Co., the Mohawk Mining Co., and the Calumet & Hecla Mining Co.

Copper ore produced in Lake Superior district, Mich., 1916–1921.

Year.	Quantity	Yield of copper.
	Short tons.	*Per cent.*
1916	12,364,114	1.08
1917	12,400,723	.99
1918	11,321,365	.96
1919	7,690,253	1.16
1920	5,938,967	1.30
1921	3,610,648	1.20

Ore milled and copper derived therefrom by Michigan companies in 1918–1921.

[Compiled from the annual reports of the producing companies.]

Company.	1918		1919		1920		1921		
	Quantity.	Yield per ton.	Quantity.	Yield per ton.	Quantity.	Yield per ton.	Quantity.	Yield per ton.	Refined copper produced.
	Short tons.	*Pounds.*	*Short tons.*	*Pounds.*	*Short tons.*	*Pounds.*	*Short tons.*	*Pounds.*	*Pounds.*
Ahmeek	1,196,541	20.8	756,870	22.80	822,192	24.9	212,170	29.48	6,255,200
Allouez	514,888	13.73	235,312	15.94	131,643	18.98			
Baltic	293,601	34.44	235,832	33.35	175,357	37.71	195,816	34.15	7,608,847
Calumet & Hecla	2,876,392	20.42	1,830,760	23.91	1,560,240	27.87	261,320	37.75	9,865,400
Centennial	159,040	15.67	87,688	15.57	41,418	13.55			
Champion	594,235	36.599	503,030	39.053	321,664	42.419	531,780	39.018	20,719,307
Franklin	273,964		109,565						
Hancock	227,049	13.40							
Isle Royale	974,508	15.9	724,667	17.95	591,971	17.94	116,576	21.37	2,491,000
La Salle	176,423	10.388	32,995	10.326	3,430	17.41			
Mass	196,456	17.33	123,780	15.86					
Michigan	40,865	28.81	62,373	27.21	46,289	23.23			
Mohawk	454,293	23.73	560,734	22.93	434,988	23.61	688,273	20.42	14,054,235
New Arcadian	10,195	16.0							
Osceola	1,194,967	13.3	739,364	14.60	455,982	16.37			
Quincy	1,174,147	16.99	960,393	20.28	809,263	23.75	767,100	22.12	16,960,265
Seneca							14,398	32.388	466,323
South Lake	7,694	28.09							
Superior	106,213	15.78	27,267	20.68	9,549	33.81			
Trimountain	201,433	26.52	171,995	30.66	116,768	30.24	143,172	30.32	4,341,584
Victoria	106,730	14.37	89,206	14.00	61,031	16.50	20,400		273,916
White Pine	194,568	16.83	84,008	23.56	93,260	19.85			
Winona	57,837	14.157	39,654	14.153					
Wolverine[a]	303,498	15.185	298,089	15.306	257,294	15.282	263,053	13.838	3,640,303

[a] Figures cover fiscal year ending June 30

Owing to high wages, high prices of coal, power, and other mining supplies, high freight rates, and rapidly increasing stocks of copper, the Calumet & Hecla, Ahmeek, and Isle Royale companies suspended operations entirely April 1, 1921. The properties of the Allouez, Centennial, Osceola, and White Pine companies remained closed during the entire year. Salaries and wages for all employees of all companies were reduced 25 per cent April 16.

During the first half of 1921 the Copper Range Co. operated at a loss of about $200,000, but profits during the last half of the year fully balanced this loss. The cost per pound of copper produced by the Copper Range companies (Baltic, Champion, and Trimountain) was 12.74 cents, exclusive of a charge of 3.73 cents for depletion and depreciation. In 1920 the cost per pound was 17.77 cents, exclusive of a charge of 4.16 cents for depletion and depreciation.

A material decrease in cost of production was made by the Mohawk Mining Co. through a reduced salary scale and decreased coal costs after the opening of navigation. In 1921 43 per cent more development work in opening up ground in advance of mining was accomplished than in 1920. The Mohawk Mining Co. has not been operating at a reduced rate, and owing to the closing down of neighboring mines during the first part of the year it was enabled to increase its labor force to the normal number by August 1.

The Quincy Mining Co. operated at a minimum rate in 1921 and suffered losses, like most of the other copper-producing companies. Eighty per cent of the losses were incurred before June, as the company was then operating on supplies purchased at peak prices in 1920. The company considered it more advisable to operate throughout the year at a greatly reduced rate than to discontinue operations entirely.

The Seneca Copper Corporation entered into an agreement with the Hancock Consolidated Mining Co. in May, 1921, for the purchase of its interest in the Lake Milling, Smelting & Refining Co. This purchase will give the corporation stamping capacity for treating from 1,000 to 1,200 tons of rock a day.

MONTANA.

Inclusive of 1921 Montana has made a total output of 8,061,394,471 pounds of blister copper, or 27 per cent of the total output of the United States since 1845. The production dropped from 177,743,747 pounds of copper in 1920 to 49,471,206 pounds in 1921, and the State fell from second place among the copper-producing States to fourth. The output comes almost entirely from the Butte district.

Butte district.—The Butte district has produced more copper than any other district in the United States from 1845 through 1921, the total being 8,015,008,000 pounds, out of 30,107,655,570 pounds for the entire country.

In 1921 negotiations were carried on regarding the purchase by the Anaconda Copper Mining Co. of the American Brass Co.'s stock, as the Anaconda Co. wanted to be "in a position to control the outlets of its metals and to promote the sale and distribution of copper and brass products," and on February 10, 1922, more than 99 per cent of the shares were transferred. In 1921 the Anaconda Copper Mining Co. perfected a copper shingle by which most of the

objections to copper roofing, except high initial cost, have been eliminated. The copper shingles make very attractive roofs of great durability and of little or no cost for upkeep. The durability and low ultimate cost of the shingle on long-life roofs, together with the choice of color and the beauty of the roof, are winning for it well-deserved popularity.

Copper and associated metals produced in Butte district, Mont., 1916–1921.

Year.	Copper.	Average yield in copper.	Gold.	Silver.
	Pounds.	*Per cent.*	*Ounce per ton.*	*Ounces per ton.*
1916	349,500,000	2.81	0.0059	1.79
1917	270,500,000	2.81	.0056	1.84
1918	321,104,000	2.17	.0059	2.03
1919	169,051,000	2.16	.0071	2.69
1920	176,399,000	1.76	.0062	2.11
1921	47,958,000	2.10	.0119	4.37

Copper, gold, and silver produced by Anaconda Copper Mining Co. from company ores, 1916–1921.

Year.	Ore treated.	Copper.	Silver.	Gold.	Dividends.
	Short tons.	*Pounds.*	*Ounces.*	*Ounces.*	
1916	5,273,066	307,395,092	10,790,705	92,099	$17,484,375
1917	3,906,901	239,014,880	8,368,180	58,545	19,815,625
1918	4,350,446	272,923,031	10,076,748	64,318	.....
1919	1,794,358	129,781,031	6,744,262	42,526	9,325,000
1920	1,828,380	138,763,065	6,420,026	32,530	6,993,750
1921	395,239	32,267,345	2,137,062	8,619	.....

The annual report of the Anaconda Co. for 1921 states that

Operations at Butte were conducted on a restricted scale during the first three months of the year. There were mined 353,055.50 wet tons of ore, and 8,115.64 tons of precipitates were produced. At the concentrator there were treated 373,409.81 tons of ore, 43,053.12 tons of slimes from the ponds, and 224,576.90 tons of tailings. The leaching plant treated 148,900 tons of tailings, from which there were produced 841.68 tons of cement copper.

The Anaconda smelter, including the concentrator, treated for all companies 456,492.78 tons of ore. Of the total amount, 395,238.51 tons of ore were produced by the mines of the company, 54,200.27 tons of ore were either purchased from or treated for other companies, and 7,054 tons of material were from the old plants at Anaconda and Butte. No copper ores were treated at Great Falls except a small tonnage of concentrates from Anaconda used for the fluxing of zinc-plant residue.

There were produced 36,257,591 pounds of fine copper, 2,269,875.23 ounces of silver, and 8,725,890 ounces gold. Of this production, 32,267,345 pounds fine copper, 2,137,062.25 ounces silver, and 8,618.538 ounces gold were produced for your company.

The refinery at Great Falls produced during the year 41,842,790 pounds of cathodes, all of which were melted into shapes at that point.

The North Butte Copper Co. operated at approximately 25 per cent of capacity during the first part of 1921, but because of the demoralized condition of the copper market discontinued operations entirely on March 23. Development work was maintained at a reduced rate, and mining costs were considerably lowered.

Copper, silver, and gold produced by North Butte Mining Co., 1916–1921.

Year.	Copper ore and precipitates treated.	Copper.	Silver.	Gold.	Dividends.
	Short tons.	*Pounds.*	*Ounces.*	*Ounces.*	
1916	544,456	24,498,181	1,047,063	1,712	$1,075,000
1917	296,773	14,493,452	662,845	959	1,075,000
1918	453,356	20,680,695	891,157	1,375	430,000
1919	287,800	14,331,254	633,215	914	.....
1920	315,233	16,666,819	693,633	1,004	.....
1921	24,755	1,229,600	34,536	78	.....

Operations of East Butte Copper Mining Co. for 1921.

Ore mined (wet weight).....	short tons...	87,469
Average assay value.....	per cent..	4.88
Cost of mining per ton, including development.....		$6.91
Company ore treated (dry weight).....	short tons..	85,009
Customs ore treated (dry weight).....	do....	66,123
Total ore treated.....	do....	151,132
Copper produced.....	pounds..	14,766,017
Silver produced.....	ounces..	508,680
Gold produced.....	do....	990
Gross value of metals shipped.....		$2,413,119.03
Other income.....		18,519.55
Gross income from operations.....		2,431,638.58
Cost of mining, treatment, freight, selling, refining, and cost of custom ore purchased.....	$2,219,404.52	
Miscellaneous operations.....	10,398.58	
		2,229,803.10
Profit on copper mining operations.....		201,835.48
Less depreciation.....		27,941.74
		173,893.74
Less outside exploration.....		23,121.25
Surplus from all operations.....		150,772.49
Copper produced.....	pounds..	14,766,017
Price per pound received, New York.....	cents..	12.5020
Cost of production per pound delivered, New York..	do....	11.2804
Profit per pound.....	do....	1.2216
Average price per ounce received for silver, New York.....	do....	99.4113
Price per ounce received for gold, New York.....		$20.00

The East Butte Copper Mining Co. was one of the few copper-producing companies to operate throughout the year and made a profit of $201,835.48, compared with $260,200 in 1920. The average assay of copper in ores was 4.88 per cent, compared with 4.02 per cent in 1920 and 3.71 per cent in 1919. The company states that this increase is due to a more efficient sorting of the ore rather than to working ore of higher grade.

There was no serious or prolonged interruption to operations throughout the fiscal year ended June 30, 1921, at the mines of the

Davis-Daly Copper Co. During this period 128,960 tons of ore was produced, which yielded 8,456,062 pounds of copper, 1,463,182.452 ounces of silver, 2,608.214 ounces of gold, 2,127,290 pounds of lead, and 5,060,368 pounds of zinc.

The Tuolumne Copper Mining Co. operated during January, February, and March, but the demoralized market forced the copper smelters to close down early in April and thus forced the discontinuance of operations by this company.

Operations of Tuolumne Copper Mining Co. at Main Range mine, 1918–1921.

Year.	Ore mined (wet).	Copper content.	Silver content.	Gold content.	Net smelter returns.
	Short tons.	*Per cent.*	*Ounces per ton.*	*Ounce per ton.*	
1918	25,405	2.253	8.082	0.0075	$248,220.63
1919	28,655	2.094	8.128	.0075	217,553.06
1920	30,521	2.0266	9.9497	.0075	265,332.33
1921	4,129	2.9599	8.2577	.0075	30,020.85

NEVADA.

From 1845 to the end of 1921 Nevada produced a total of 957,508,434 pounds of copper, representing 3 per cent of the total output of the country and giving the State fifth rank among the copper-producing States. In 1921 Nevada produced 15,129,116 pounds of copper, compared with 55,580,322 pounds in 1920, and ranked eighth among the copper-producing States.

Ely district.—The Ely district, White Pine County, to the end of 1921 produced about 826,666,000 pounds of copper or 3 per cent of the total output of the country. It produced 2 per cent of the output in 1921. In total production it ranked eighth among the copper districts of the country, and in production for 1921 it ranked twelfth.

Smelter production of metals in Ely (Robinson) district, Nev., 1916–1921.

Year.	Ore.	Copper produced.	Average yield in copper.	Gold and silver, per ton of ore.
	Short tons.	*Pounds.*	*Per cent.*	*Cents.*
1916	4,053,526	93,037,587	1.14	20
1917	4,466,017	93,615,355	1.05	18
1918	4,519,445	92,396,638	1.02	24
1919	2,273,961	[a] 47,871,048	1.05	17
1920	2,589,546	[a] 48,347,828	.93	21
1921	400,810	[a] 10,282,527	1.28	25

[a] Mine production.

Metals produced by Nevada Consolidated Copper Co., 1916–1921.

Year.	Ore treated.	Average assay of copper.	Average extraction of copper.	Gold and silver recovered per ton.	Refined copper produced.	Dividends.
	Short tons.	*Per cent.*	*Per cent.*	*Cents.*	*Pounds.*	
1916	3,922,634	1.632	73.87	20.44	90,735,287	$7,497,963
1917	4,064,095	1.462	73.08	.....	82,040,508	8,297,746
1918	3,999,526	1.506	69.95	.....	76,607,062	6,498,235
1919	2,135,425	1.599	70.49	.....	43,971,892	2,999,186
1920	2,568,588	1.449	70.20	.....	48,311,985	1,499,593
1921	392,645	1.49	75.23	.....	9,362,325	.....

Disseminated ore reserves of Nevada Consolidated Copper Co., Dec. 31, 1921.

	Ruth.		Pits.		Total.	
	Short tons.	Per cent of copper.	Short tons.	Per cent of copper.	Short tons.	Per cent of copper.
Total ore developed to Dec. 31, 1920	15,689,768	2.22	82,700,457	1.47	98,390,225	1.58
Total ore mined to Dec. 31, 1921	4,636,540	1.95	30,352,476	1.55	34,989,016	1.60
Recoverable ore remaining Jan. 1, 1922	11,053,228	2.33	52,347,981	1.42	63,401,209	1.58

The Nevada Consolidated Copper Co. operated at approximately 40 per cent of average capacity during the first quarter of 1921 and suspended operations entirely on March 31. The net operating loss was $775,823.32, or about 39 cents a share, and included tax accruals, all fixed and general overhead costs, and expenses involved in the shutdown of the mines, mill, and smelter. The high-grade direct-smelting ore discovered in 1920, along the margin of the Ruth concentrating ore body, was prospected and developed during the period of shutdown, with the result that at the end of the year 400,000 tons of direct-smelting ore, averaging above 7 per cent, was fully developed. The company expects that substantial additional ore will be opened up as development work progresses. Porphyry ore of good milling grade disclosed in the course of this work has not been included in the estimates of reserves given above.

The property of the Consolidated Coppermines Co. remained idle throughout the year.

Yerington district.—In the Yerington district in 1921 neither development nor mining operations were carried on by the Mason Valley Mines Co. The production of the district has fallen from 17,139,000 pounds in 1918 to nothing in 1921.

Copper produced in Yerington district, Nev., 1916–1921.

	Pounds.		Pounds.
1916	3,491,000	1919	3,077,000
1917	19,396,000	1920	1,046,000
1918	17,139,000	1921	

NEW MEXICO.

The production of blister copper from New Mexico in 1921 was 18,076,909 pounds, compared with 52,159,751 pounds in 1920. From 1845 to 1921 New Mexico had a recorded output of 716,203,395 pounds of copper, or 3 per cent of the total output of the country. The principal producing districts are in Grant and Hidalgo counties.

Santa Rita district.—From the best sources available it is estimated that the total production of copper to the end of 1921 in the Santa Rita district has been 626,783,000 pounds.

Copper produced in Santa Rita district, N. Mex., 1916–1921.

	Pounds.		Pounds.
1916	74,228,000	1919	40,359,000
1917	82,200,000	1920	44,400,000
1918	77,547,000	1921	9,138,000

The Chino Copper Co. began producing late in 1911.

Metals produced by Chino Copper Co., N. Mex., 1916–1921.

Year.	Ore milled.	Copper content.	Mill recovery.	Production of refined copper.	Gold, silver, and miscellaneous income per pound.	Dividends.
	Short tons.	*Per cent.*	*Per cent.*	*Pounds*	*Cents.*	
1916	3,094,400	1.83	66.59	72,319,508	0.260	$7,177,335
1917	3,608,100	1.64	69.32	79,636,235	.159	8,612,802
1918	3,836,400	1.63	63.275	75,655,641	.109	[a]3,914,910
1919	1,765,200	1.82	65.67	40,488,706	.216	[b]2,609,940
1920	1,838,140	1.76	70.67	44,051,849	.570	[c]978,728
1921	361,660	1.70	77.36	9,137,282	.570	.....

[a] $1,087,475 represents distribution of capital.
[b] Total represents distribution of capital, no dividends paid during 1919.
[c] $652,485 represents distribution of capital.

The Chino Copper Co. operated at approximately 30 per cent of capacity during the first quarter of 1921, but suspended mining operations on April 8 and milling operations on April 12. The net loss incurred was $127,764.49. A recalculation of ore reserves completed on January 1, 1921, indicated an unmined reserve of 103,462,552 tons, averaging 1.53 per cent of copper; 1,834,444 tons, containing 1.41 per cent of copper, in the stock piles at Santa Rita; and 88,465 tons, containing 1.37 per cent of copper, in a special reserve used for experimental purposes—a total reserve on December 31, 1921, of 105,385,461 tons, averaging 1.53 per cent of copper. The total ore developed by churn drilling through April, 1921, including ore mined, was 127,335,159 tons, containing 1.58 per cent of copper.

Burro Mountain district.—The Burro Mountain district, southwest of Silver City, produced 4,496,121 pounds of copper in 1921. The total production from the district has probably been about 68,669,000 pounds. The net production from the mines of the Burro Mountain Copper Co. was 4,496,121 pounds of copper and 16,366 ounces of silver.

Metals produced by Burro Mountain Copper Co., N. Mex., 1921.

	Short tons (dry weight).	Per cent of copper.	Copper produced.	Silver produced.
			Pounds.	*Ounces.*
Concentrates	18,062	12.872	4,452,887	16,355.52
Precipitates	73	30.920	43,234	9.98
	18,135	12.945	4,496,121	16,365.50

Lordsburg district.— The Lordsburg district, in Hidalgo County, has been a steady producer of copper for several years.

Copper produced in Lordsburg district, N. Mex., 1916–1921, in pounds.

[Mine figures.]

1916	4,755,000	1919	3,516,000
1917	4,262,000	1920	2,696,000
1918	2,215,000	1921	579,000

TENNESSEE.

The production of blister copper in Tennessee in 1921 was 15,084,294 pounds, compared with 16,727,803 pounds in 1920. The entire output came from the Ducktown district, in the extreme southeastern part of the State, in Polk County. To the end of 1921 the total output of this district has been 398,553,000 pounds.

Metals produced in Ducktown district, Tenn., 1916–1921.

[Smelter figures.]

Year.	Ore treated.	Copper produced.	Average yield of copper.	Gold and silver per ton of ore.
	Short tons.	*Pounds.*	*Per cent.*	*Cents.*
1916	482,495	14,556,278	1.52	14
1917	589,004	16,093,757	1.37	15
1918	529,012	15,053,568	1.42	18
1919	555,018	15,629,454	1.41	21
1920	589,853	16,727,803	1.42	21
1921	564,457	15,084,294	1.34	18

The annual report of the Tennessee Copper & Chemical Co. states that in spite of the unfavorable conditions in the copper and fertilizer industries the company was able to continue operations on a moderate scale and made a net operating profit of $526,348 as compared with $162,651 for 1920.

The Burra Burra mine was the only mine belonging to this company which operated throughout the year, but the London mine operated until September 10. Development work at the Burra Burra and London mines was continued at a greater rate than was warranted by production, and the mines are considered in very good condition.

Ore reserves at the Burra Burra, London, and Polk County mines were estimated at 3,609,677 tons of ore, of which 93,500 tons was broken in stopes.

Copper and sulphuric acid produced by Tennessee Copper & Chemical Corporation, 1916–1921.

Year.	Ore smelted.	Copper.	Sulphuric acid of 60° Baumé.	Total cost of copper per pound.	Dividends.
	Short tons.	*Pounds.*	*Short tons.*	*Cents.*	
1916	385,188	9,404,295	181,637	14.36	$150,000
1917	457,902	10,547,708	262,857	14.90	
1918	402,071	9,819,838	283,092	18.526	392,817
1919	413,877	10,414,815	266,627	18.715	
1920	404,060	10,358,237	333,629	19.135	
1921	302,584	8,018,577	242,743	16.705	

UTAH.

The total smelter production of copper from Utah to the end of 1921 amounted to 2,408,562,961 pounds, or 8 per cent of the total domestic production since 1845. The smelter production in 1921 was 45,831,959 pounds. The State ranks fourth in total production and fifth in production for 1921.

Bingham district.—Inclusive of 1921 the Bingham district has produced 2,065,091,000 pounds of copper, or 7 per cent of the total production of the country since 1845. In 1921 the mine production decreased to 28,011,000 pounds, or 6 per cent of the total production of the United States for the year. The district ranks fourth in total production and sixth in output for 1921.

Copper produced in Bingham district, Utah, 1916–1921.

[Mine figures.]

	Pounds.		Pounds.
1916	223,620,000	1919	116,697,000
1917	225,412,000	1920	110,670,000
1918	211,195,000	1921	28,011,000

The Utah Copper Co. is by far the largest producer in the district and in the State.

Metals produced by Utah Copper Co. from ore milled, 1916–1921.

Year.	Ore milled.	Copper content.	Mill recovery.	Copper.[a]	Gold and silver per pound of copper.	Net cost per pound of copper.[b]	Dividends.
	Short tons.	*Per cent.*	*Per cent.*	*Pounds.*	*Cents.*	*Cents.*	
1916	10,994,000	1.44	62.34	187,531,824	0.65	6.92	$19,493,880
1917	12,542,000	1.337	61.10	195,837,111	.70	10.95	[c] 23,555,105
1918	12,160,700	1,226	65.11	188,092,405	.79	14.53	[d] 16,244,900
1919	5,538,700	1.26	78.46	105,088,740	.83	12.366	[e] 9,746,940
1920	5,556,800	1.16	81.38	101,897,758	.81	13.145	[f] 9,746,940
1921	1,220,700	1.16	83.87	24,511,593	[g] 1.15	11.57	[h] 4,061,225

[a] Net production, not copper content of concentrates.
[b] Value of precious metals and railway earnings deducted.
[c] Includes $2,842,857 capital distribution.
[d] Includes $3,655,102.50 capital distribution.
[e] Includes $7,797,552 capital distribution.
[f] Includes $7,403,997.35 capital distribution.
[g] Includes miscellaneous income. Comparative figure for 1920 is 2.09 cents.
[h] Total represents capital distribution.

Cost of mining, milling, and concentrating copper ore by Utah Copper Co., 1916–1921.

Year.	Ore.	Cost per ton.			
		Mining.	Transportation.	Milling.	Total.
	Short tons.				
1916	10,994,000	$0.2781	$0.2792	$0.3782	$0.9355
1917	12,542,000	.4446	.2794	.6930	1.4170
1918	12,160,700	.5370	.2983	.9277	1.7630
1919	5,538,700	.4900	.3040	1.2062	2.0002
1920	5,556,800	.4823	.2591	1.2472	1.9886
1921	1,220,700	.4998	.1921	1.1679	1.8598

The Utah Copper Co. discontinued operations April 4 after operating at less than 50 per cent of capacity during the first quarter of the year. Ore reserves calculated from previous estimates amount to 362,910,100 tons averaging 1.35 per cent of copper. The company reports that churn drilling has proved the existence of considerable additional ore of good commercial grade but that this ore has not yet been formally added to fully developed reserves.

Regular stripping operations were discontinued April 1, but 42,768 cubic yards of capping was removed during the second and third quarters of the year, making a total for the year of 355,231 cubic yards and a grand total to December 31, 1921, of 53,399,265 cubic yards.

No carbonate ore was mined or shipped to the leaching plant in 1921. The Magna plant was idle throughout the year, but the Arthur mill operated through April 4.

Net earnings from production during the year were $257,901.53 and miscellaneous income brought the total to $782,088.20, or about 41 cents a share, as contrasted with $3.03 a share for 1920. Against this income has been charged a total of $2,840,197.17, consisting of expenditures for protection and maintenance of properties while idle, depreciation of plant and equipment, loss on copper sold at less than inventory valuation after production ceased and loss on marketable securities and sundry charges, making a net decrease in surplus account of $2,058,108.97. Disbursements of $2.50 a share, or a total of $4,061,225, were made to stockholders during the year, bringing the total so distributed to December 31, 1921, to $115,570,887.50.

The Utah Consolidated Copper Co. under ordinary circumstances is the second largest producer in the district, but in 1921 the Montana-Bingham Consolidated Mining Co. made a larger production.

Copper, gold, and silver produced by Utah Consolidated Mining Co., 1916–1921.

Year.	Ore.	Copper content.	Copper.[a]	Gold per ton.	Silver per ton.	Dividends.
	Short tons.	*Per cent.*	*Pounds.*	*Ounce.*	*Ounces.*	
1916	360,034	1.734	12,211,118	0.052	0.796	$1,125,000
1917	226,536	1.797	7,968,165	.050	.764	1,050,000
1918	221,651	2.03	8,476,197	.054	.82	450,000
1919	126,893	2.22	5,710,346	.07	1.27	.....
1920	57,747	2.457	3,187,492	.0525	1.33	.....
1921	1,183	2.07	41,073	.026	.69	.....

[a] Includes copper derived from lead ores.

Reserves of copper ore at the Utah Consolidated mine were estimated at 837,000 tons averaging 1.97 per cent of copper and 0.57 ounce of silver and 0.04 ounce of gold to the ton.

Owing to the good fluxing quality of the ore of the Montana-Bingham Consolidated Mining Co., an agreement was made with the Garfield smelter, which enabled the mine to ship throughout the year. In 1921 the output of shipping ore of this company was the greatest in its history and represented about one-third of its total production.

Metals produced by the Montana-Bingham Consolidated Mining Co., 1919–1921.

Year.	Ore produced.	Metal contents.				Smelter returns.
		Gold.	Silver.	Copper.	Lead.	
	Short tons.	*Ounces.*	*Ounces.*	*Pounds.*	*Pounds.*	
1919	3,855,380	205,598	14,114	505,906	53,201	$76,065.93
1920	4,660,550	348,606	12,663	750,210	16,278	79,382.77
1921	24,525,680	1,354,941	42,869	1,581,857	21,402	140,188.82

The Bingham Mines Co. operated its Dalton and Lark group of mines during the year, with the results shown below:

Copper, lead, gold, and silver produced by the Bingham Mines Co. from the Dalton and Lark mines in 1921.

	Ore.		Copper.	Lead.	Gold.	Silver.
	Wet tons.	*Dry tons.*	*Pounds.*	*Pounds.*	*Ounces.*	*Ounces.*
Lead	463.82	439.43	11,012	157,136	41.571	4,231.04
Copper	24,478.11	23,634.50	234,405	.....	1,613.682	65,256.71
	24,941.93	24,073.93	245,417	157,136	1,655.253	69,487.75

The Dalton and Lark mines of the Bingham Mines Co. were operated throughout the year because of the peculiar conditions prevailing in the mines, which made it more economical to operate at a small loss than to close down entirely.

Tintic district.—The production of copper from the Tintic district is largely incidental to the production of other metals. The quantity of local ore in which copper is the most valuable metal is very small. It is estimated that inclusive of 1921 the district has made a total production of 154,349,000 pounds of blister copper.

Copper produced in Tintic district, Utah, 1916–1921.

[Mine figures.]

	Pounds.		Pounds.
1916	7,107,000	1919	3,251,000
1917	9,118,000	1920	3,003,000
1918	6,569,000	1921	1,570,000

Beaver district.—Inclusive of 1921 the Beaver district has yielded about 49,151,000 pounds of copper.

Copper produced in Beaver County, Utah, 1916–1921.

[Mine figures.]

	Pounds.		Pounds.
1916	3,204,000	1919	539,000
1917	3,702,000	1920	47,000
1918	2,636,000	1921	28,000

REFINERY PRODUCTION.

The refinery output of copper in the United States in 1921 was made by 11 plants, 9 of which employed the electrolytic method and 3 employed the furnace process on Lake Superior copper, the Calumet & Hecla plant employing both methods. Six of the large electrolytic refineries are on the Atlantic tidewater and the three Lake refineries are on the Great Lakes; only two plants are located west of the Great Lakes—one at Great Falls, Mont., and one at Tacoma Wash. In addition to these refineries there are numerous plants in different parts of the country that make a considerable output from old copper, brass, and other alloys of copper. The output of the regular refining plants is in the form of casting, Lake, and electrolytic copper.

CASTING AND PIG COPPER.

Blister copper that is low in precious metals and sufficiently free from impurities for certain uses is refined by the furnace process and ordinarily cast into ingots. This copper is usually unfit for uses requiring a high-grade copper, such as electric transmission, brass manufacture, and rolling, but is suitable for copper castings, and a large part of it is put to that use. Lake copper excepted, a comparatively small percentage of the copper output carries so small a content of precious metals that, together with the added value of electrolytic copper, it will not more than pay for the electrolytic refining of the copper; consequently the output of casting copper is small. Some blister or pig copper low in precious metals has been exported without further treatment and is probably consumed without electro-

lytic refining. A large percentage of the pig and casting copper shown in the table is from Arizona. Some of the districts produce a rather high grade of blister copper carrying a small amount of precious metals, and it is found profitable to market some of it without electrolytic refining. During 1921 the production of furnace-refined new casting copper amounted to 1,740,393 pounds and of unrefined pig and best select copper to 222,878 pounds.

LAKE COPPER.

By Lake copper, as the term is used in this report, is meant the output of the Lake smelters. A considerable portion of this output is refined electrolytically, but most of the electrolytically refined Lake copper is mixed with furnace-refined copper or is sold as some brand of Lake copper. Of the 100,918,001 pounds of copper produced by the Lake smelters, about 27,434,650 pounds was refined electrolytically, either to free the copper from impurities or to recover the silver content.

ELECTROLYTIC COPPER.

Under electrolytic copper, in the table below, is included all new copper that was refined electrolytically, except that from the Lake district that was marketed as Lake copper. In 1921 the production of electrolytic copper from primary materials of domestic origin amounted to approximately 506,533,000 pounds, and from materials of foreign origin to 405,338,000 pounds, and in addition 82,017,000 pounds was produced from secondary sources—a total electrolytic production of 993,888,000 pounds for the year.

REFINED COPPER.

The total output of new refined copper in 1921 was 1,020,000,000 pounds, a decrease of 615,000,000 pounds from that of 1920.

Primary and secondary copper produced by regular refining plants and imported in 1913 and 1918–1921, in pounds.

	1913	1918	1919	1920	1921
Primary:					
Domestic [a]—					
Electrolytic	1,022,497,601	1,560,327,422	1,233,994,324	1,010,240,867	506,532,984
Lake	155,715,286	231,096,158	177,594,135	153,483,952	100,918,001
Casting	22,606,040	15,284,635	18,223,145	13,905,114	1,740,393
Pig and best select	36,004,986	76,165,976	3,674,191	4,793,307	222,878
	1,236,823,913	1,882,874,191	1,433,485,795	1,182,423,240	609,414,256
Foreign [a]—					
Electrolytic	378,243,869	[b] 492,181,364	[b] 370,558,779	[b] 450,194,958	[b] 405,337,490
Casting and best select	.....	57,329,735	1,262,227	2,290,446	5,275,350
	1,615,067,782	2,432,385,290	1,805,306,801	1,634,908,644	1,020,027,096
Secondary:					
Electrolytic	14,862,577	34,674,062	32,408,548	32,856,549	82,017,382
Casting	22,360,182	9,018,049	38,876,481	49,130,510	24,467,951
	37,222,759	43,692,111	71,285,029	81,987,059	106,485,333
Total output	1,652,290,541	2,476,077,401	1,876,591,830	1,716,895,703	1,126,512,429

[a] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.
[b] Includes refined copper imported.

If the output of plants treating purely secondary material is added to the production of the regular refining companies, the contribution from plants in the United States to the world's supply of copper for 1921 is found to be 1,454,627,000 pounds.

SECONDARY COPPER.

Under secondary copper is considered material recovered from remelting old copper, copper scraps, and copper recovered from the treatment of copper alloys or alloys that are treated without the separation of the copper. A canvass of plants producing secondary copper has been made by J. P. Dunlop, of the United States Geological Survey,[2] and the following figures are taken from his report.

Secondary copper, 1921.

	Short tons.
Copper as metal	99,020
Copper in alloys other than brass	14,330
	113,350
From new scrap	28,400
From old scrap	84,950
	113,350
Brass scrap melted:	
New clean scrap	81,300
Old scrap	67,200
	148,500
Copper content of brass scrap (averaging about 70 per cent copper):	
New scrap	56,910
Old scrap	47,040
	103,950
Total copper produced from secondary sources:	
From new scrap	85,310
From old scrap	131,990
	217,300
Exports of scrap brass in 1921	2,969
Exports of scrap copper in 1921	308
Imports of scrap brass in 1921	20,449
Imports of scrap copper in 1921	2,853

In addition to the secondary material treated by the regular refining companies, plants that treated secondary material exclusively produced a total of about 328,115,000 pounds of copper as copper and in brass and other alloys of copper, making a total production of 434,600,000 pounds from secondary sources. Of this total at least 170,620,000 pounds was produced by remelting clean scrap produced in the manufacture of copper and brass articles.

Refined copper from secondary sources produced in the United States, 1916–1921, in pounds.

1916	700,000,000	1919	574,380,000
1917	766,800,000	1920	624,920,000
1918	705,340,000	1921	434,600,000

[2] Dunlop, J. P., Secondary metals: U. S. Geol. Survey Mineral Resources, 1921, pt. 1, p. 158, 1922.

COPPER SULPHATE.

The production of hydrous copper sulphate or bluestone by the copper refineries of the United States in 1921 was 26,097,993 pounds, having a copper content of 6,646,000 pounds, compared with 29,330,463 pounds, having a copper content of 7,823,000 pounds, in 1920.

STOCKS.

Stocks of copper Jan. 1, 1916–1922, in pounds.

Year.	Refined copper.	Blister and material in process of refining.[a]
1916	82,429,666	274,000,000
1917	128,055,229	424,000,000
1918	114,000,000	411,000,000
1919	180,000,000	562,600,000
1920	631,000,000	273,000,000
1921	659,000,000	465,000,000
1922	459,000,000	283,000,000

[a] Does not include copper in stock at foreign smelters or in transit from foreign smelters to refineries in the United States.

IMPORTS AND EXPORTS.

The quantity of copper in unmanufactured form imported into the United States in 1921 was 350,472,611 pounds, according to the records of the Bureau of Foreign and Domestic Commerce. The imports in 1920 were 485,670,691 pounds.

Copper imported into the United States in 1920 and 1921, by countries, in pounds.

[General imports.]

Country.	Ore (copper content).	Concentrates (copper content).	Matte and regulus (copper content).	Unrefined black copper and copper in bars, pigs, or other forms.	Refined in bars, plates, rods, or other forms.	Old and clippings for remanufacture.	Composition metal, copper chief value.
1920.							
United Kingdom	1,256,948	.....	71,982	5,939,811	1,437,027	4,830,953	2,148,843
France	41,842	.....	76,109	3,073,425	3,258,043	4,822,375	54,092
Germany	.....	.....	617,940	130,957	60	806,041	566,625
Spain	2,123,594	.....	.....	.....	1,194,975	.....	.....
Canada	22,022,211	2,922,633	3,611,518	26,287,350	750,916	883,614	132,255
Mexico	883,716	25,931,336	7,361,140	72,670,790	.....	5,648	.....
Cuba	7,786,690	10,659,959	.....	.....	.....	61,387	.....
Chile	9,668,396	4,559,655	4,282,856	46,289,793	101,000,138	6,722	23,850
Peru	1,064,501	148,401	863,328	82,509,806	.....	.....	.....
Japan	.....	.....	.....	.....	.....	.....	.....
Other countries	7,197,393	2,575,606	709,301	7,794,392	1,102,139	141,627	1,309,982
	52,045,291	46,797,590	17,594,174	244,696,324	108,743,298	11,558,367	4,235,647
1921.							
United Kingdom	347,506	.....	26,400	3,721,557	12,404	1,216,687	484,151
France	647,591	.....	209,755	2,870,093	3,785,138	113,363	90,916
Germany	2,693,084	.....	3,844,157	5,207,032	95,032	60,345	294,653
Spain	4,475,091	.....	688,905	7,000	.....	220,792	.....
Canada	2,495,612	723,271	402,385	22,073,731	80,477	3,715,472	.....
Mexico	439,539	10,104,379	3,866,319	16,450,113	51,581	419	.....
Cuba	7,293,930	10,662,517	.....	.....	.....	84,661	.....
Bolivia	1,380,182	.....	.....	.....	.....	.....	.....
Chile	29,630,105	8,821,689	3,408,973	39,242,226	62,312,518	.....	.....
Peru	2,928,806	450,319	740,782	72,016,068	.....	.....	.....
Venezuela	1,383,377	.....	173,665	.....	.....	8,676	.....
Australia	.....	.....	.....	4,490,799	.....	.....	.....
British South Africa	1,256,602	.....	1,200,348	.....	460,852	.....	.....
Portuguese Africa	309,344	.....	.....	4,890,520	2,364,026	.....	.....
Other countries	1,397,179	12,171	785,937	766,140	87,253	286,481	111,515
	56,677,948	30,774,346	15,347,626	171,735,279	69,249,281	5,706,896	981,235

Copper (in unmanufactured form) imported into the United States, 1916–1921.

[General imports.]

	Pounds.		Pounds.
1916	462, 335, 980	1919	429, 387, 594
1917	556, 420, 297	1920	485, 670, 691
1918	575, 805, 115	1921	350, 472, 611

The exports of metallic copper (exclusive of ore, concentrates, and composition metal) from the United States in 1921 amounted to 628,415,714 pounds, according to the Bureau of Foreign and Domestic Commerce.

Copper exported from the United States, 1916–1921.

Year.	Pounds.		Total value.
	Metallic.[a]	Total.	
1916	784, 006, 486	789, 791, 254	$206, 163, 241
1917	1, 125, 647, 336	1, 132, 832, 663	338, 723, 756
1918	744, 243, 481	747, 689, 580	195, 840, 637
1919	515, 595, 019	516, 627, 775	117, 417, 055
1920	623, 158, 489	624, 053, 701	127, 468, 606
1921	628, 415, 714	628, 804, 750	85, 351, 928

[a] Exclusive of ore, concentrates, and composition metal.

Copper sulphate (blue vitriol) exported from the United States, 1916–1921.

Year.	Pounds.	Value.
1916	19, 469, 565	$2, 803, 833
1917	29, 068, 748	3, 038, 380
1918	14, 477, 339	1, 395, 946
1919	9, 140, 673	928, 291
1920	3, 783, 409	306, 899
1921	3, 582, 933	217, 491

Copper exported from the United States, 1920–21, by kind and destination, in pounds.

1920.

Destination.	Ore (copper content).	Concentrates, matte and regulus (copper content).	Unrefined black copper and copper in bars, pigs, or other forms.	Refined, in bars, ingots, rods, or other forms.	Composition metal, copper chief value.	Old and scrap.	Pipes and tubes.	Plates and sheets.	Wire (except insulated).	Total.
United Kingdom			1,523,080	99,479,801	168,587		1,751	501,495	8,955,431	110,630,145
Belgium				28,090,450				131,062	105,975	28,327,487
Denmark				7,622,661			130	2,820	1,893,959	9,519,570
France			32,906	118,489,043			81	112,000	79,126	118,713,156
Germany				89,194,588					1,905,967	91,100,555
Italy				918,802	38,546		173,510	150,432	1,201,570	2,482,860
Netherlands				34,228,046			113,156	74,728	8,213,227	42,629,157
Norway				2,145,297		22,158	59,644	132,142	5,235,163	7,594,404
Switzerland				1,232,063				50,029	70	1,282,162
Other Europe				40,854,975			33,304	80,846	4,269,235	45,238,360
Canada	248,320	25,000	172,790	29,697,098	30,758	539,063	743,989	1,868,376	600,202	33,925,596
Japan	392			82,913,730			12,902	625	75,012	83,002,661
Other countries		167,194	114,517	16,360,239	216,415	16,098	3,760,756	19,694,593	9,277,776	49,607,588
	248,712	192,194	1,843,293	551,226,793	454,306	577,319	4,899,223	22,799,148	41,812,713	624,053,701

Copper exported from the United States, 1920–21, by kind and destination, in pounds—Continued

1921.

Destination.	Ore (copper content).	Concentrates, matte and regulus (copper content).	Unrefined black copper and copper in bars, pigs, or other forms.	Refined, in bars, ingots, rods,[a] or other forms.	Composition metal, copper chief value.	Old and scrap.	Pipes and tubes.	Plates and sheets.	Wire (except insulated).	Rods.[b]	Total.
United Kingdom				62,334,868				213,184	1,964,232	6,559,714	71,071,998
Belgium				26,619,837					2,887		26,622,724
Denmark				2,331,630					5,450	2,016,584	4,353,664
France			22,408	98,731,640			800	448,020	56,564		99,259,432
Germany				233,072,479				224,040		224,185	233,520,704
Italy				16,369,962				44,775	114,472		16,529,209
Netherlands				28,646,940				11,648	98,637	210,175	28,967,400
Norway				970,036					2,004,222	441,670	3,415,928
Spain				8,403,156			7,974	141,897	366,216		8,919,243
Sweden				8,755,398		2,960			9,360	44,910	8,812,628
Switzerland				67,200				23,344	112,000		202,544
Other Europe				2,190,511				16,434	1,098,294		3,305,239
Canada	299,150		121,863	7,198,649	15,374	248,654	831,775	1,735,508	176,785	3,256,976	13,884,734
China				37,040,754			2,197	11,259	80,650		37,134,860
Japan				59,170,325		357,859			119,456		59,647,640
Other countries		60,970	6,042	4,213,862	13,542	6,473	1,405,757	2,235,807	5,197,772	16,578	13,156,803
	299,150	60,970	150,313	596,117,247	28,916	615,946	2,248,503	5,105,916	11,406,997	12,770,792	628,804,750

[a] Rods separately classified after July 1, 1921.
[b] Rods included under "Refined, in ingots, bars, rods, or other forms" prior to July 1, 1921, when separate classification was made.

Brass exported from the United States in 1920–21.

	1920		1921	
	Pounds.	Value.	Pounds.	Value.
Scrap and old	2,060,468	$254,189	5,938,002	$405,871
Bars, plates, and sheets	5,810,733	1,671,608	2,874,762	741,110
Cartridge shells, empty	.....	122,193	.....	66,019
Pipes and fittings	.....	2,141,217	.....	1,006,633
Wire	1,159,087	398,328	578,836	172,558
All other manufactures of brass	.....	10,541,116	.....	5,884,156
	9,030,288	15,128,651	9,391,600	8,270,347

Unmanufactured brass exported from the United States, 1917–1921.

[Bars, plates, and sheets.]

Year.	Pounds.	Value.
1917	328,346,666	$101,521,426
1918	30,989,717	9,522,934
1919	7,770,671	2,310,561
1920	5,810,733	1,671,608
1921	2,874,762	741,110

CONSUMPTION.

The refined new copper withdrawn from the total year's supply on domestic account in 1921 was 611,000,000 pounds; in 1920 it was 1,054,000,000 pounds. The method employed in determining the quantity of copper retained for consumption is shown in the following table, which does not include stocks of copper held by consumers:

New refined copper withdrawn from total year's supply on domestic account,[a] 1913 and 1918–1921, in pounds.

	1913	1918	1919	1920	1921
Total supply of new copper	1,615,067,782	2,432,385,290	1,805,306,801	1,634,908,644	1,020,027,096
Stock at beginning of year	105,497,683	114,000,000	180,000,000	631,000,000	659,000,000
Total available supply	1,720,565,465	2,546,385,290	1,985,306,801	2,265,908,644	1,679,027,096
Copper exported [b]	817,911,424	704,715,714	439,835,229	553,070,086	609,038,352
Stock at end of year	90,385,402	180,000,000	631,000,000	659,000,000	459,000,000
Total withdrawn from supply	908,296,826	884,715,714	1,070,835,229	1,212,070,086	1,068,038,352
Withdrawn on domestic account	812,268,639	1,661,669,576	914,471,572	1,053,838,558	610,988,744

[a] Formerly called "Apparent domestic consumption."
[b] Includes unrefined black blister and converter copper (bars, pigs, and other forms) and refined in ingots, bars, rods, or other forms.

If to the 611,000,000 pounds of new refined copper is added the 435,000,000 pounds of secondary copper and copper in alloys produced during the year, it is found that a total of about 1,046,000,000 pounds of new and old copper was available for domestic consumption.

As may be seen from the method of calculation, the figures represent the quantity of new copper withdrawn from supply on domestic

account but not actual domestic consumption, as they take no account of consumer's stocks. Furthermore, much of the copper exported is in manufactured forms; consequently much of the copper bought on domestic account during any year is exported in manufactured forms at a later date. As the records of the Bureau of Foreign and Domestic Commerce do not separate refined manufactured and unmanufactured copper, no close calculation of actual domestic consumption can be made.

USES.

There are no data available showing the quantity of copper that entered the different industries, and the great changes due to the war render any estimate more uncertain than usual.

The following table shows the copper cast in different forms in 1921. It will be noted that the total is not the same as the production of refined copper:

Copper cast in different forms in 1921.

Form.	Pounds.	Per cent.
Wire bars	650,000,000	61
Ingots	215,000,000	20
Cakes	126,000,000	12
Cathodes	21,000,000	2
Other forms	53,000,000	5
	1,065,000,000	100

PRICES.

The average price received for copper delivered by the producers in 1921 and the price used by the United States Geological Survey in calculating the value of the copper output was 12.9 cents a pound. The average received by selling agencies for 1,180,000,000 pounds as reported to the Geological Survey by the agencies, was 12.909 cents a pound.

Price per pound of copper, 1850–1921.[a]

1850	$0.22	1868	$0.23	1886	$0.111	1904	$0.128
1851	.166	1869	.242	1887	.138	1905	.156
1852	.22	1870	.212	1888	.168	1906	.193
1853	.22	1871	.241	1889	.135	1907	.20
1854	.22	1872	.356	1890	.156	1908	.132
1855	.27	1873	.280	1891	.128	1909	.13
1856	.27	1874	.220	1892	.116	1910	.127
1857	.25	1875	.227	1893	.108	1911	.125
1858	.23	1876	.21	1894	.095	1912	.165
1859	.22	1877	.19	1895	.107	1913	.155
1860	.23	1878	.166	1896	.108	1914	.133
1861	.22	1879	.186	1897	.12	1915	.175
1862	.22	1880	.214	1898	.124	1916	.246
1863	.34	1881	.182	1899	.171	1917	.273
1864	.47	1882	.191	1900	.166	1918	.247
1865	.392	1883	.165	1901	.167	1919	.186
1866	.342	1884	.13	1902	.122	1920	.184
1867	.254	1885	.108	1903	.137	1921	.129

[a] Weed, W. H., Copper Handbook, vol. 11, pp. 1339, 1343, for years 1850–1903. By computation from data for years 1850-60, p. 1339. Survey computations for electrolytic copper since 1904. For 1916 and later years average price all marketable grades.

Average monthly prices at New York per pound of electrolytic copper in 1916-1921, in cents, as reported by the American Metal Market Co.

Month.	1916	1917	1918	1919	1920	1921
January	24.10	30.26	23.50	20.05	19.02	12.85
February	27.46	35.22	23.50	16.91	18.61	12.79
March	27.44	35.74	23.50	15.01	18.36	12.23
April	29.31	32.19	23.50	15.40	18.54	12.54
May	29.81	32.32	23.50	16.005	18.28	12.83
June	27.49	32.57	23.50	17.655	17.97	12.76
July	25.60	28.90	25.89	21.71	18.61	12.35
August	27.36	27.13	26.00	22.22	18.44	11.76
September	28.26	25.45	26.00	21.95	18.04	12.105
October	28.64	23.50	26.00	21.505	16.30	12.75
November	32.22	23.50	26.00	19.96	14.39	13.16
December	33.84	23.50	25.285	18.48	13.48	13.67
Average	28.46	29.19	24.68	18.905	17.50	12.65

Average monthly quoted prices at New York per pound of electrolytic copper in 1916–1921, in cents, as reported by the Engineering and Mining Journal.

Month.	1916	1917	1918	1919	1920	1921
January	24.008	28.673	23.50	(a)	18.918	12.597
February	26.440	31.750	23.50	16.763	18.569	12.556
March	26.310	31.481	23.50	14.856	18.331	11.976
April	27.895	27.935	23.50	15.246	18.660	12.438
May	28.625	28.788	23.50	15.864	18.484	12.742
June	26.601	29.962	23.50	17.610	18.065	12.697
July	23.865	26.620	25.904	21.604	18.576	12.170
August	26.120	25.380	26.00	22.319	18.346	11.634
September	26.855	25.073	26.00	21.755	18.144	11.948
October	27.193	23.500	26.00	21.534	15.934	12.673
November	30.625	23.500	26.00	19.758	14.257	13.035
December	31.890	23.500	(a)	18.295	13.138	13.555
Average	27.202	27.180	24.628	18.691	17.456	12.502

[a] No market.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA.

(MINES REPORT.)

By C. N. Gerry.[1]

PRODUCTION.

GENERAL STATEMENT.

The value of the mine production of gold, silver, copper, lead, and zinc in Montana in 1921 decreased more than 75 per cent from that of 1920, as the larger mines were closed about nine months of the year. Silver Bow County, which includes the Butte or Summit Valley district, continued to produce most of the silver, copper, lead, and zinc, but most of the gold was mined in other districts. No dividends were declared by mining companies in 1921.

Mine production of gold, silver, copper, lead, and zinc in Montana, in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	457	5,241,615	$1,851,165	12,579,178	177,059,260	31,253,916	184,337,786	$65,573,047
1921	445	1,324,801	1,480,763	6,558,713	48,098,730	20,366,917	23,275,966	16,324,521
Decrease, 1921	12	3,916,814	370,402	6,020,465	128,960,530	10,886,999	161,061,820	49,248,526

[a] Includes placer production.

ORE.

The ore sold or treated in Montana decreased nearly 75 per cent, and the average value per ton decreased from $12.45 to $12.15. Nearly 55 per cent of the ore was concentrated, nearly 5 per cent was treated in gold and silver mills, and more than 9 per cent was shipped directly to smelters. The remainder, more than 31 per cent, consisted of ore leached and old tailings, which were shipped, concentrated, or cyanided. Mines in Silver Bow County produced more than 86 per cent of the total ore. Copper ore amounted to more than 70 per cent of the total, lead-zinc ore to nearly 9 per cent, lead ore to nearly 9 per cent, dry or siliceous ore to more than 12 per cent, and copper-lead ore to a fraction of 1 per cent.

Sulphide iron ore containing considerable gold was produced in Broadwater County. The dry ore was principally gold ore and

[1] Valuable assistance, especially in the compilation of the statistical tables of this report, was given by B. N. Patchell, of the United States Geological Survey.

silver ore. The different kinds of shipping ore and concentrates with their contents are given in the tables on pages 289–290. Copper concentrates exceeded all other kinds, but of the crude ore shipped dry or siliceous ore predominated.

GOLD.

The output of gold in Montana decreased 20 per cent. Since 1915 the decrease has been $3,523,432. Madison County had the largest output, followed by Lewis and Clark and Silver Bow counties. Most of the placer gold resulted from the dredge operations in Alder Gulch, Madison County. The output of gold from Silver Bow County decreased considerably on account of the idleness of the Butte mines. More than 39 per cent of the gold was produced at amalgamation and cyanidation mills, which yielded an average recovery of $7.66 a ton of ore and tailings treated. More than 17 per cent of the gold was contained in concentrates of all kinds, and crude ore shipped to smelters contained nearly 27 per cent of the total. More than 66 per cent of the gold came from dry or siliceous ores, nearly 7 per cent from copper ore, more than 15 per cent from placers, more than 6 per cent from lead-zinc ore, and nearly 6 per cent from lead ore; but gold decreased from all these sources except siliceous ore and lead ore.

More than 56 per cent of the total gold in 1921 was produced from seven properties. The Shannon property, near Marysville, was the largest producer. The others were the Conrey placers, North Moccasin, the copper properties of the Anaconda Co., Missouri, Revenue, and the zinc properties of the Anaconda Co.

SILVER.

Silver produced by mines in Montana decreased nearly 48 per cent in quantity and $7,152,591 in value. Most of the silver was obtained from lead-zinc ore and copper ore; the former yielded 30 per cent of the total and the latter more than 25 per cent. Nearly 76 per cent of the silver came from Silver Bow County. Cyanidation and amalgamation mills produced only a fraction of 1 per cent of the silver, concentrates nearly 63 per cent, crude ore shipped to smelters more than 34 per cent, and ore leached and old tailings smelted or leached nearly 3 per cent.

Eight properties produced more than 76 per cent of the silver, and each of these produced more than 200,000 ounces. Four of the large mining properties produced more than 800,000 ounces each—the copper and zinc mines of the Anaconda Co. and the Hibernia and Elm Orlu mines. The other large producers were the Colorado, Neihart Consolidated, Granite-Bimetallic, and Philipsburg mines.

COPPER.

The mine production of copper in Montana decreased nearly 73 per cent and was only about 15 per cent of the output of 1918.

Silver Bow County, which includes the Butte district, contributed all the copper except 140,781 pounds. Copper ore was the source of nearly all the copper, though lead-zinc ores contributed nearly 2 per cent. Crude ore of all kinds shipped to smelters contained nearly 14 per cent of the copper and concentrates more than 71 per

cent. The sulphide copper ore of smelting grade contained 6,439,962 pounds, an average content of 6.75 per cent, and the oxidized copper ores only 1,424 pounds, an average of 3.24 per cent. Old tailings, slag, and copper precipitates produced from mine waters contained 7,166,340 pounds.

Five mines in Montana each produced more than 1,000,000 pounds of copper in 1921. The mines of the Anaconda Copper Mining Co. produced more than all others combined. Other large producers were the East Butte, Davis Daly, and North Butte mines.

LEAD.

The mine production of lead in Montana decreased nearly 35 per cent from that of 1920, and 65 per cent of the output was derived from mines in Silver Bow County. Lead-zinc ore was the source of more than 58 per cent of the lead, lead ore yielded more than 36 per cent, and dry or siliceous ore nearly 5 per cent. Crude ore of all kinds shipped to the smelters contained more than 27 per cent of the total lead, concentrates nearly 71 per cent, and old tailings and slags more than 2 per cent. Most of the first-class lead ore was sulphide.

Nearly all the lead came from six properties, four of which produced more than 1,500,000 pounds each. In the order of output these four were the zinc mines of the Anaconda Co. and the Hibernia, Elm Orlu, and Block P. properties. The Hartley mine at Neihart became a large producer.

ZINC.

The mine production of recoverable zinc in Montana decreased more than 87 per cent. Many of the zinc mines were idle the greater part of the year, and the Butte & Superior mine, the largest producer of zinc in Montana, made no shipments. Lead-zinc ore was the source of all the recoverable zinc, and nearly all of it came from Silver Bow County. No zinc material was shipped east in 1921, and all the lead-zinc concentrate from the Butte mines was shipped to the electrolytic zinc plant at Great Falls.

Three mines at Butte produced nearly all the zinc—the Anaconda (zinc), Hibernia, and Elm Orlu.

Ore and metal produced in Montana in 1921.

Source of production.	Ore.		Gold.		Silver.	
	Short tons.	*Per cent.*	*Fine ounces.*	*Per cent.*	*Fine ounces.*	*Per cent.*
Dry gold ore	96,504	7.28	41,684.11	58.19	50,991	0.78
Dry gold and silver ore	1,401	.10	715.66	1.00	11,565	.18
Dry silver ore	67,001	5.06	4,978.18	6.95	1,484,354	22.63
Copper ore	928,461	70.08	4,733.30	6.61	1,663,472	25.36
Lead ore	113,481	8.57	4,151.98	5.80	1,352,125	20.62
Copper-lead ore	334	.03	10.59	.01	26,244	.40
Lead-zinc ore	117,619	8.88	4,369.18	6.10	1,968,371	30.01
Total deep mines	1,324,801	100.00	60,643.00	84.66	6,557,122	99.98
Total placers	.....	.....	10,988.91	15.34	1,591	.02
Total, deep and placers, 1921	1,324,801	100.00	71,631.91	100.00	6,558,713	100.00
Total, deep and placers, 1920	5,241,615	.....	89,550.11	.....	12,579,178	.....
Decrease, 1921	3,916,814	.....	17,918.20	.....	6,020,465	.....

Ore and metal produced in Montana in 1921—Continued.

Source of production.	Copper.		Lead.		Zinc.	
	Pounds.	*Per cent.*	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*
Dry gold ore	23,121	0.05	57,235	0.28	.....	.....
Dry gold and silver ore	3,084	.01	3,976	.02	.....	.....
Dry silver ore	59,263	.12	895,444	4.40	.....	.....
Copper ore	46,888,812	97.48	1,029	.01	.....	.....
Lead ore	215,114	.45	7,414,293	36.40	11,167	0.05
Copper-lead ore	24,388	.05	166,526	.82	.....	.....
Lead-zinc ore	884,948	1.84	11,828,414	58.07	23,264,799	99.95
Total deep mines	48,098,730	100.00	20,366,917	100.00	23,275,966	100.00
Total deep mines, 1920	177,059,260	.....	31,253,916	.....	184,337,786	.....
Decrease, 1921	128,960,530	.....	10,886,999	.....	161,061,820	.....

Content of dry gold ores sold or treated in Montana in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Beaverhead	5,591	473.12	7,376	11,994	27,600
Broadwater	2,563	1,945.00	388	2	.....
Deer Lodge	4,737	3,895.74	184	650	.....
Fergus	15,099	3,906.38	922	.....	.....
Granite	2,534	2,312.15	4,079	6,654	1,031
Jefferson	6,318	1,322.47	1,154	1,242	4,117
Lewis and Clark	46,174	17,820.79	15,930	.....	.....
Lincoln	15	3.91	2	.....	.....
Madison	13,443	9,951.71	20,765	2,579	23,598
Mineral	1	.21	2	.....	.....
Park	5	4.54	1	.....	.....
Powell	15	22.30	153	.....	889
Ravalli	1	10.50	.....	.....	.....
Silver Bow	8	15.30	35	.....	.....
	96,504	41,684.12	50,991	23,121	57,235

Content of dry gold and silver ores sold or treated in Montana in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Jefferson	133	58.92	1,359	2,809	.....
Lewis and Clark	12	11.02	267	176	.....
Madison	1,251	641.50	9,830	.....	3,772
Powell	5	4.20	109	99	204
	1,401	715.64	11,565	3,084	3,976

Content of dry silver ores sold or treated in Montana in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Beaverhead	67	1.23	2,677	85	1,003
Broadwater	23	1.35	505	18	.....
Cascade	597	176.61	29,545	2,098	6,389
Deer Lodge	21,807	358.00	135,136	.....	.....
Fergus	19	.40	835	.....	.....
Granite	9,474	631.33	428,294	4,014	263,188
Jefferson	2,467	124.52	40,118	6,883	15,742
Lewis and Clark	338	16.80	13,714	249	3,343
Madison	174	64.44	7,893	11	2,605
Mineral	33	.....	649	.....	.....
Powell	67	15.20	1,653	1,972	868
Sanders	17	.....	478	.....	980
Silver Bow	31,918	3,588.29	822,857	43,933	601,326
	67,001	4,978.17	1,484,354	59,263	895,444

Content of copper ores sold or treated in Montana in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Jefferson	114	15.24	1,387	8,866	.....
Lewis and Clark	22	13.00	578	1,424	1,029
Madison	28	1.12	34	10,059	.....
Missoula	97	7.40	1,183	12,108	.....
Sanders	21	.43	17	2,858	.....
Silver Bow	928,179	4,696.13	1,660,273	46,853,497	.....
	928,461	4,733.32	1,663,472	46,888,812	1,029

Content of lead ores sold or treated in Montana in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Beaverhead	96	24.09	1,219	249	39,278	.....
Broadwater	442	24.11	6,731	141	287,358	.....
Cascade	13,931	213.57	482,550	.....	1,491,998	.....
Granite	248	49.87	18,706	4,798	46,383	.....
Jefferson	7,160	384.97	69,712	4,147	797,407	.....
Judith Basin	4,933	126.23	98,050	943	1,715,151	.....
Lewis and Clark	3,318	123.20	14,130	4,124	430,416	.....
Lincoln	14,996	306.77	31,424	.....	1,007,768	11,167
Madison	1,345	1,161.29	6,947	18,080	510,531	.....
Mineral	26	.....	1,782	.....	18,226	.....
Missoula	27	.....	150	.....	9,488	.....
Park	2	.80	71	73	1,292	.....
Powell	582	767.58	9,538	1,433	134,403	.....
Sanders	15	.....	734	375	2,337	.....
Silver Bow	66,360	969.51	610,381	180,751	922,257	.....
	113,481	4,151.99	1,352,125	215,114	7,414,293	11,167

Content of lead-zinc ores sold or treated in Montana in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Granite	3,071	75.00	77,978	5,180	110,500	363,740
Silver Bow	114,548	4,294.20	1,890,393	879,768	11,717,914	22,901,059
	117,619	4,369.20	1,968,371	884,948	11,828,414	23,264,799

MINING INDUSTRY.

In 1921 the mines of Montana suffered greatly on account of the general depression of the metal market. Though conditions seemed to improve slightly in 1920, and freight rates and wages were reduced in January, 1921, the market for copper later became so poor that in April, 1921, the Anaconda Copper Mining Co., was forced to close its mines and smelting plants, and thousands of its employees went to other camps or found work in other industries. Large producing mines at Butte dependent on the smelter at Anaconda were compelled to stop shipments, though the East Butte smelter continued to run at a reduced rate. Much silver ore and lead ore was shipped to East Helena from Butte and other camps, but many mines throughout the State were idle. In May minor sections of the plants at Anaconda and Great Falls resumed work to treat silver-

zinc ore and to aid the problem of unemployment at Butte. The production of copper was about one-fourth that of 1920, silver a little more than half, and zinc only one-eighth. The total value of the metal production was less than that of any other year since about 1887, and only one-fourth that of 1920.

METALLURGIC INDUSTRY.

Forty-one milling plants of various kinds were active in Montana in 1921, though many of them were operated for only a short time. They included 6 plants using the amalgamation process, 4 using amalgamation and concentration, 9 equipped for cyanidation, 1 using amalgamation and cyanidation, 2 using concentration and cyanidation, 4 using table concentration, and 11 using flotation equipment after table concentration. Two copper-precipitating plants that extracted copper from mine waters, 1 copper-leaching plant, and 1 electrolytic zinc-leaching plant are included in the total. A complete list of milling plants giving the process and equipment of each was prepared for the year 1920, and a copy of it may be had by addressing the Director, Bureau of Mines, Washington, D. C.

Of the ore and old tailings treated at gold and silver mills, 2,562 tons was treated by amalgamation with an average recovery per ton of $9.66 in gold and 0.34 ounce of silver and 73,437 tons by cyanidation, with an average recovery per ton of $7.59 in gold and 0.45 ounce of silver. During the year, 47 pounds of mercury and 108,665 pounds of sodium cyanide were used in gold and silver mills. The consumption of mercury was 0.018 pound of mercury per ton of ore amalgamated and 0.0225 pound of mercury per ounce of bullion recovered. The consumption of cyanide was 1.81 pounds per ounce of gold and silver bullion and 1.48 pounds per ton of ore and tailings treated. Both the ore and the bullion recovered by cyanidation increased slightly in 1921.

Gold and silver produced at mills in Montana in 1921.

County.	Ore.	Bullion recovered from ore by—				Total value.
		Amalgamation.		Cyanidation.		
		Gold.	Silver.	Gold.	Silver.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	
Beaverhead	[a] 933	83.95	12	317.64	739	$9,053
Broadwater	19	353.55	147	.....	.....	7,456
Fergus	15,099	.....	.....	3,906.38	922	81,674
Granite	[b] 461	110.49	591	.....	.....	2,875
Jefferson	2,867	57.49	34	[c] 679.16	[c] 13,486	28,748
Lewis and Clark	[d] 35,740	134.85	38	[e] 16,653.85	[e] 11,285	358,376
Madison	[f] 9,253	446.59	61	[g] 5,398.38	[g] 6,746	127,633
Park	5	.....	.....	4.54	1	95
Ravalli	1	10.50	.....	.....	.....	217
	65,378	1,197.42	883	26,959.95	33,179	616,127

[a] Also yielded 25 tons of concentrates.
[b] Also yielded 46 tons of concentrates.
[c] Includes bullion from 1,669 tons of old tailings.
[d] Also yielded 17 tons of concentrates.
[e] Includes bullion from 8,942 tons of old tailings.
[f] Also yielded 37 tons of concentrates.
[g] Includes bullion from 10 tons of old tailings.

Mills in Montana equipped for the concentration of low-grade ore treated most of the ore mined. The concentrates produced had an average value of $50.45 a ton, but the output was comparatively small, as the copper mines were closed in April.

Mine production of metals from Montana concentrates, 1921.

By counties.

County.	Ore to concentrating mills.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value of concentrates.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beaverhead	4,680	350	54.94	7,135	11,994	27,600	.....	$11,060
Cascade	6,456	1,076	75.00	53,800	.....	161,400	.....	62,613
Deer Lodge	21,807	609	358.00	135,136	.....	.....	.....	142,537
Granite	4,571	965	729.67	80,044	11,834	111,531	363,740	119,861
Judith Basin	2,322	387	21.73	11,813	.....	167,604	.....	19,804
Lewis and Clark	2,960	394	95.99	7,708	352	296,440	.....	23,077
Lincoln	15,011	1,430	310.68	31,426	.....	1,007,768	11,167	83,755
Madison	4,355	588	2,025.92	19,113	510	25,768	.....	62,217
Powell	110	22	6.10	865	1,380	7,324	.....	1,499
Silver Bow	662,661	204,629	8,783.67	3,766,480	34,344,524	12,626,527	22,901,059	10,091,746
	724,933	210,450	12,461.70	4,113,520	34,370,594	14,431,962	23,275,966	10,618,169

By kinds of concentrates.

Dry or siliceous	1,819	3,028.39	168,010	18,950	32,555	.....	$234,521
Copper	167,609	3,522.65	1,261,652	33,284,144	.....	.....	5,628,127
Lead	9,836	1,547.50	720,222	185,052	2,849,228	.....	904,299
Lead-zinc	31,186	4,363.16	1,963,636	882,448	11,550,179	23,275,966	3,851,222

Average content.

Kind of concentrates.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*	
Dry or siliceous	1,819	1.66	92.37	0.52	0.89	.....	$128.93
Copper	167,609	.02	7.53	9.93	.....	.....	33.58
Lead	9,836	.16	73.22	.94	14.48	.....	91.94
Lead-zinc	31,186	.14	62.97	1.41	18.52	37.32	123.49
	210,450	.06	19.55	8.17	3.43	5.53	50.45

Crude ore directly smelted averaged $31.17 a ton. There was a large decrease in siliceous and copper ore.

Mine production of metals from Montana crude ore shipped to smelters in 1921.

By counties.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Beaverhead	453	52.44	29,309	22,816	201,401	$42,399
Broadwater	3,009	1,616.91	7,477	161	287,358	53,853
Cascade	8,072	315.18	458,295	2,098	1,336,987	525,245
Deer Lodge	4,737	3,895.74	184	650	.....	80,800
Fergus	19	.40	835	.....	.....	843
Granite	10,295	2,228.19	448,422	8,812	309,571	509,551
Jefferson	6,892	1,159.94	84,367	22,795	440,078	131,089
Judith Basin	2,611	104.50	86,237	943	1,547,547	158,159
Lewis and Clark	1,222	1,100.12	25,588	5,621	138,348	55,281
Madison	2,623	3,949.17	19,549	30,219	514,738	128,247
Mineral	60	.21	2,433	.....	18,226	3,257
Missoula	124	7.40	1,333	12,108	9,488	3,475
Park	2	.80	71	73	1,292	155
Powell	550	803.18	10,588	2,124	129,040	33,272
Sanders	53	.43	1,229	3,233	3,317	1,804
Silver Bow	79,054	3,977.76	1,064,519	6,450,143	614,970	2,006,489
	119,785	19,212.37	2,240,436	6,561,796	5,552,361	3,733,919

By kinds of ore.

Dry or siliceous	56,522	16,034.55	1,343,985	66,310	902,256	$1,724,604
Copper	47,410	408.67	248,958	6,441,386	1,029	1,088,391
Lead	15,541	2,758.62	621,570	31,618	4,487,956	884,633
Copper-lead	312	10.53	25,923	22,482	161,120	36,291

Average content.

		Fine ounces per ton.	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	
Dry or siliceous	56,522	0.28	23.78	0.06	0.80	$30.51
Copper:						
Oxidized	22	.59	26.27	3.24	2.34	48.95
Sulphide	47,388	.01	5.24	6.79	.....	22.94
Lead:						
Oxidized	2,311	.10	38.88	.....	15.38	54.72
Sulphide	13,230	.19	40.19	.12	14.27	57.31
Copper-lead:						
Oxidized	312	.03	83.09	3.60	25.82	116.32
	119,785	.16	18.70	2.74	2.32	31.17

PRODUCTION BY COUNTIES.

GENERAL FEATURES.

In the following pages no mention is made of many districts in which production was small.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1921.

County.	Gold.					Silver.	
	Placers.		Deep mines.		Total. value.	Fine ounces.	Value.
	Fine ounces.	Value.	Fine ounces.	Value.			
Beaverhead	50.16	$1,037	509.01	$10,522	$11,559	37,522	$37,522
Broadwater	115.42	2,386	1,970.46	40,733	43,119	7,641	7,641
Cascade			390.19	8,066	8,066	512,095	512,095
Deer Lodge	5.23	108	4,253.71	87,932	88,040	135,320	135,320
Fergus	10.64	220	3,906.82	80,761	80,981	1,758	1,758
Granite	35.51	734	3,068.38	63,429	64,163	529,059	529,059
Jefferson	50.16	1,037	1,906.12	39,403	40,440	113,744	113,744
Judith Basin			126.21	2,609	2,609	98,050	98,050
Lewis and Clark	232.49	4,806	17,984.81	371,779	376,585	44,684	44,684
Lincoln	15.72	325	310.71	6,423	6,748	31,428	31,428
Madison	9,245.48	191,121	11,820.04	244,342	435,463	46,823	46,823
Meagher	11.42	236			236	3	3
Mineral	377.18	7,797	.19	4	7,801	2,443	2,443
Missoula	113.63	2,349	7.40	153	2,502	1,338	1,338
Park	44.89	928	5.32	110	1,038	79	79
Powell	433.88	8,969	809.26	16,729	25,698	11,518	11,518
Ravalli	96.12	1,987	10.50	217	2,204	7	7
Sanders			.44	9	9	1,229	1,229
Silver Bow	150.98	3,121	13,563.43	280,381	283,502	4,983,972	4,983,972
	10,988.91	227,161	60,643.00	1,253,602	1,480,763	6,558,713	6,558,713

County.	Copper.		Lead.		Recoverable zinc.		Total. value.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
Beaverhead	36,716	$4,736	234,407	$10,548			$64,365
Broadwater	161	21	287,358	12,931			63,712
Cascade	2,098	271	1,498,387	67,427			587,859
Deer Lodge	650	84					223,444
Fergus							82,739
Granite	20,646	2,663	421,102	18,950	363,740	$18,187	633,022
Jefferson	23,947	3,089	817,266	36,777			194,050
Judith Basin	943	122	1,715,151	77,182			177,963
Lewis and Clark	5,973	771	434,788	19,566			441,606
Lincoln			1,007,768	45,350	11,167	558	84,084
Madison	30,729	3,964	540,506	24,323			510,573
Meagher							239
Mineral			18,226	820			11,064
Missoula	12,108	1,562	9,488	427			5,829
Park	73	9	1,292	58			1,184
Powell	3,504	452	136,364	6,136			43,804
Ravalli							2,211
Sanders	3,233	417	3,317	149			1,804
Silver Bow	47,957,949	6,186,575	13,241,497	595,867	22,901,059	1,145,053	13,194,969
	48,098,730	6,204,736	20,366,917	916,511	23,275,966	1,163,798	16,324,521

Ore sold or treated, mines producing, and average value per ton of ores in Montana in 1920 and 1921.

County.	Ore sold or treated, 1921 (short tons).		Number of deep mines producing.		Average value per ton.[a]		Average value per ton in gold and silver.[a]	
	Quantity.	Increase or decrease.	1920	1921	1920	1921	1920	1921
Beaverhead	6,088	−8,023	13	15	$20.31	$10.40	$6.97	$7.89
Broadwater	3,028	+2,077	18	20	54.25	20.25	18.63	15.97
Cascade	14,528	−8,007	25	17	36.63	40.46	25.48	35.80
Deer Lodge	26,544	+22,101	7	5	32.99	8.41	32.58	6.41
Fergus	15,118	−839	6	3	8.62	5.46	8.61	5.46
Granite	15,327	−4,212	42	32	40.11	41.25	39.07	38.66
Jefferson	16,192	−22,978	70	67	23.69	11.92	15.43	9.46
Judith Basin	4,933	+4,933	.....	9	.....	36.08	.....	20.41
Lewis and Clark	49,864	−3,388	40	36	9.28	8.76	8.00	8.35
Lincoln	15,011	−15,864	1	3	13.91	5.58	3.87	2.52
Madison	16,241	+11,604	49	57	29.04	19.59	23.91	17.84
Meagher	.....	−63	2	.....	41.30	.....	.46	.....
Mineral	60	−319	3	3	34.85	54.28	11.73	40.62
Missoula	124	+86	1	2	30.79	28.02	8.55	11.98
Park	7	−20,285	3	2	4.38	35.57	3.99	26.00
Powell	669	−801	9	15	18.31	51.97	10.79	42.13
Ravalli	1	+1	.....	1	.....	217.00	.....	217.00
Sanders	53	+5	3	3	71.98	34.04	20.00	23.36
Silver Bow	1,141,013	−3,872,834	99	58	12.15	11.56	2.43	4.61
Toole	.....	−8	1	.....	134.50	.....	33.38	.....
	1,324,801	−3,916,814	392	348	12.45	12.15	2.91	5.90

[a] Value per ton, placer product excluded.

Number and production of producing placer mines in Montana in 1920 and 1921.

County.	1920						1921					
	Mines.			Gold.	Silver.	Total value.	Mines.			Gold.	Silver.	Total value.
	Hydraulic, dry, and sluicing.	Dredging.	Drift.				Hydraulic, dry, and sluicing.	Dredging.	Drift.			
					Fine ounces.						*Fine ounces.*	
Beaverhead	1	.....	.....	$498	1	$499	5	.....	1	$1,037	6	$1,043
Broadwater	5	.....	1	5,183	32	5,218	9	.....	.....	2,386	17	2,403
Carbon	1	.....	.....	71	.....	71	.....	.....	.....	.....	.....	.....
Deer Lodge	.....	.....	.....	.....	.....	.....	1	.....	.....	108	.....	108
Fergus	.....	.....	.....	.....	.....	.....	1	.....	.....	220	1	221
Granite	5	.....	.....	3,278	45	3,327	8	.....	.....	734	2	736
Jefferson	4	.....	.....	592	12	605	9	.....	.....	1,037	14	1,051
Lewis and Clark	14	.....	.....	2,412	22	2,436	17	.....	.....	4,806	65	4,871
Lincoln	.....	.....	.....	.....	.....	.....	2	.....	.....	325	2	327
Madison	5	1	.....	256,307	2,001	258,488	4	1	.....	191,121	1,354	192,475
Meagher	1	.....	.....	153	1	154	2	.....	.....	236	3	239
Mineral	5	.....	.....	9,827	18	9,847	8	.....	.....	7,797	10	7,807
Missoula	6	.....	.....	658	2	660	9	.....	.....	2,349	5	2,354
Park	2	.....	.....	472	3	475	2	.....	1	928	7	935
Powell	7	.....	1	6,504	47	6,555	11	.....	1	8,969	65	9,034
Ravalli	1	.....	.....	130	.....	130	2	.....	.....	1,987	7	1,994
Sanders	1	.....	.....	24	.....	24	.....	.....	.....	.....	.....	.....
Silver Bow	4	.....	.....	2,837	26	2,866	3	.....	.....	3,121	33	3,154
	62	1	2	288,946	2,210	291,355	93	1	3	227,161	1,591	228,752

BEAVERHEAD COUNTY.

The output of ore in Beaverhead County decreased 8,023 tons in 1921, though much work was accomplished in building mills.

Argenta district.—Four deep mines in the Argenta district produced 99 tons of ore, containing $583 in gold, 1,027 ounces of silver, 249 pounds of copper, and 35,271 pounds of lead, valued in all at $3,229, or $32.62 a ton. Sulphide lead ore was shipped from the Midnight and Tilden properties and oxidized ore from the Tuscarora mine.

Bald Mountain district.—One lot of silver ore was marketed from the Sulphide claim.

Bannack district.—Three deep mines and three placers in the Bannack district produced 704 tons of ore, $5,185 in gold, 208 ounces of silver, 106 pounds of copper, and 296 pounds of lead, valued in all at $5,420. The ore was valued at $6.99 a ton. Some ore from the Hendricks mine was treated by amalgamation and cyanidation. Placer bullion was marketed from the Little Bell and other properties.

Beaverhead district.—The I. X. L. and Gold Leaf placers were operated a short time in 1921.

Big Hole district.—The New Discovery placer was operated about six months and produced some gold by sluicing.

Bryant district (Melrose).—The Hecla group, 16 miles from Melrose, produced several hundred tons of oxidized copper-lead ore containing considerable silver. The property is said to have 20 miles of underground workings, and the ore occurs in dolomite.

Elkhorn district (Wise River).—The Boston-Montana Corporation completed its concentration-flotation mill in December and operated the plant about half a month. It is planned to treat 750 tons of ore a day, and the following flow sheet was published.[2]

The specifications for the tramway from mine to mill call for electric motors to haul twelve 3-ton cars. Two gyratories, each capable of crushing 250 tons in eight hours, will give the ore its first treatment, the crushed product going to the fine ore bins. Thence by automatic feeders to 8 feet by 48 inches Hardinge mills, where it will be crushed to 30 mesh. Thence it will go to classifiers and to 8 James roughing tables, the concentrates going to 4 James finishing tables. From the finishing tables the tailings will go to 7 feet by 36 inches Hardinge mills, where they will be crushed to 60 mesh. Dorr thickeners, 40 feet in diameter, will be used, followed by 16 Janney flotation cells. These in turn being followed by 50-foot Dorr thickeners and Oliver filters. There will be in all 24 James tables each with a capacity of 50 tons daily, with 16 for roughing and 8 for finishing. There will be 4 Hardinge ball mills, 2 for coarse grinding and 2 for fine.

Lead concentrate was shipped to East Helena, Mont., and copper concentrate to Tacoma. The property is said to have 7 miles of tunnels and drifts, and the ore occurs in fissure veins in granite. The quantity of developed ore has been variously reported and is a matter of considerable speculation by those interested.

Nogo district.—A test lot of oxidized lead ore was shipped from the Millionaire prospect, near Apex.

Vipond district.—One lot of silver ore, containing argentite and cerargyrite (silver chloride), was shipped from the Argyle property to the East Butte smelter, and bullion was recovered by concentration and cyanidation at the De Celles property, formerly belonging to the Butte Vipond Mining Co.

[2] Eng. and Min. Jour., vol. 112, p. 193, July 30, 1921.

BROADWATER COUNTY.

The ore mined in Broadwater County in 1921 had a value of $20.25 a ton, and most of it was first-class siliceous gold ore.

Backer district (Canton).—Two deep mines and four placers in the Backer district produced 11 tons of ore, $7,881 in gold, and 153 ounces of silver. As in former years, the Slim Jim property produced rich gold ore, which was amalgamated. Small placer operations were carried on in the Confederate Gulch and White's Gulch.

Beaver district.—Small lots of ore were shipped from the Alice, New York, and Iron Age properties.

Cedar Plains district (Radersburg).—Four placers and nine deep mines in the Cedar Plains district produced 2,919 tons of ore, $33,616 in gold, 7,049 ounces of silver, 20 pounds of copper, and 280,781 pounds of lead, valued in all at $53,303. The ore had an average value of $17.70 a ton. The Charity Gulch and Crow Creek placers produced considerable gold. The largest production came from the Keating mine, which produced an iron ore containing about $12 in gold. Several hundred tons of oxidized lead ore was shipped from the Daisy-Dandy property, and the North Home mine produced both silver ore and oxidized lead ore.

Park district (Townsend).—Small shipments of ore and bullion from the Park district contained $895 in gold, 238 ounces of silver, 141 pounds of copper, and 3,543 pounds of lead, valued in all at $1,310.

CASCADE COUNTY.

Mine production in Cascade County, Mont., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	25	22,535	$17,345	510,832	6,474	3,127,148	$825,515
1921	17	14,528	8,066	512,095	2,098	1,498,387	587,859
Increase or decrease, 1921	−8	−8,007	−9,279	+1,263	−4,376	−1,628,761	−237,656

At Black Eagle near Great Falls the electrolytic zinc plant, copper refinery, and rod and wire mill of the Anaconda Copper Mining Co. were operated the first three months of 1921, until the mines of Butte were closed. The copper plant has five blast furnaces, two reverberatories, and two converters. In 1921 one blast furnace was used to treat lead material and the resultant bullion was shipped East for refining. Later in the year silver-zinc ore was concentrated at Anaconda, the electrolytic zinc plant was operated on part time, and the rod and wire mill was active. The output of refined copper and zinc is given in the report of the Anaconda Copper Mining Co. under Silver Bow County. The zinc plant was fully described in a recent article.[3] It consists mainly of roasters (14 at Black Eagle and 14 at Anaconda), acid tanks, Pachuca tanks, classifiers, Dorr thickeners, Oliver filters, Shriver presses, electrolytic tank house, zinc-dust plant, and casting building.

[3] Laist, Frederick, Frick, F. F., Elton, J. O., and Caples, R. B., Electrolytic zinc plant of Anaconda Copper Mining Co. at Great Falls, Mont.: Am. Inst. Min. Eng. Trans., vol. 64, pp. 699–763, 1920.

The output of Cascade County was that of the Montana district (Neihart). The Barker district, formerly in Cascade County, is referred to under the newly organized Judith Basin County.

The Broadwater & Moulton property, operated by the Cascade Consolidated Silver Mines Co., was a large producer of silver and lead, from both crude ore and concentrates. The property was not operated the entire year, however, as the mill was burned in May, and the production was exceeded by that of the Hartley mine of the Neihart Consolidated Silver Mining Co. Several thousand tons of first-class sulphide lead ore containing much silver was shipped to East Helena, Mont., and new machinery was installed at the mine. Other producers worthy of mention were the Big Seven, Florence, Black Bird, Galt, Lizzie, Silver Belt, and Queen. Most of the mining property in the Montana district was operated on a leasing basis, and conspicuous ore minerals are cerusite, galena, and pyrargyrite.

DEER LODGE COUNTY.

Mine production in Deer Lodge County, Mont., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	
1920	7	4,443	$121,512	21,328	9,993	$146,599
1921	6	26,544	[a] 88,040	135,320	650	223,444
Increase or decrease, 1921	−1	+22,101	−33,472	+113,992	−9,343	+76,845

[a] Includes small placer production.

The output of Deer Lodge County consisted of silver ore and gold-bearing iron ore, which was used as a flux in smelting. At Anaconda, where most of the ores mined in Montana are treated, the copper-leaching plant, copper and zinc concentrators, copper-smelting plant, and arsenic plant were active about three months. The plant has 11 blast furnaces, 10 reverberatories, and 7 converters. In June the zinc mill resumed operations, but the copper plant remained idle.

Georgetown district (Southern Cross).—Four deep mines in the Georgetown district produced 4,737 tons of ore, containing $80,532 in gold, 184 ounces of silver, and 650 pounds of copper, valued in all at $80,800, or $17.06 a ton. Oxidized iron ore, used as a flux at the smelters, was shipped from the Hold Fast, Oro Fino, Pyrenees, and Short Shift properties. Ore from the Pyrenees mine also contained pyrite and arsenopyrite.

Oro Fino district.—The Champion Mining Co. operated a 150-ton concentration-flotation mill from February to the end of the year, and shipped several hundred tons of concentrate rich in gold and silver.

FERGUS COUNTY.

Mine production in Fergus County, Mont., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	6	15,957	$132,187	4,739	1,008	358	$137,567
1921	4	15,118	*a* 80,981	*a* 1,758	.....	.....	82,739
Decrease, 1921	2	839	51,206	2,981	1,008	358	54,828

a Includes placer production.

All the ore produced in Fergus County was siliceous, and most of it was treated by cyanidation. The ore milled had an average value of $5.41 a ton.

Cone Butte district.—One lot of rich silver ore was shipped from the Dardanelles mine.

North Moccasin district (Kendall).—The North Moccasin mine, near Kendall, was operated nine months by the Moccasin Leasing Co. and produced considerable gold in a 300-ton cyanidation plant. The following statement [4] was given by the company owning the mine:

> Lessees operated from March to November with a production of 14,704 tons of ore of an average assay value of $5.22 per ton. * * * Approximately 50 per cent of the above tonnage came from below the 500 level, 20 per cent from the levels above, and 30 per cent from surface cuts and tunnels. All workings below the 500 level were stripped of rails and air pipe, and abandoned.

Warm Springs district (Giltedge).—The mill at the Maginnis mine was operated several months during the summer and produced several lots of gold bullion, which was sent to the Helena assay office.

GRANITE COUNTY.

Mine production in Granite County, Mont., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.*a*	Silver.*a*	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	47	19,539	$51,599	656,099	77,093	76,033	.....	$787,015
1921	40	15,327	64,163	529,059	20,646	421,102	363,740	633,022
Increase or decrease, 1921	−7	−4,212	+12,564	−127,040	−56,447	+345,069	+363,740	−153,993

a Includes placer production.

The quantity of ore sold or treated in Granite County in 1921 decreased 4,212 tons, and the value of the metal output, which was mostly silver, decreased nearly 20 per cent.

Alps district.—A small quantity of ore from the Rainy Day mine was treated in a 5-ton amalgamation mill.

First Chance district (Garnet).—Eight deep mines and five placers in the First Chance district produced 981 tons of ore, $39,264 in gold,

[4] Barnes King Development Co. Ann. Rept. for year ending Dec. 31, 1921.

2,403 ounces of silver, and 1,031 pounds of lead, valued in all at $41,714. The ore had an average value of $41.86 a ton. Placer operations were carried on at the Hill Top, Spot Dog, Top of Deep, Bear Gulch, and Barney Gulch properties. Several hundred tons of ore, consisting principally of pyrite, containing gold and silver, was shipped from the Grant & Hartford property, near Garnet. The Mitchell-Mussigbrod mine produced first-class gold ore and milling ore that was treated by concentration and amalgamation.

Flint Creek district (*Philipsburg*).—Sixteen deep mines in the Flint Creek district produced 12,611 tons of ore, containing $15,514 in gold, 508,150 ounces of silver, 8,631 pounds of copper, 388,875 pounds of lead, and 363,740 pounds of recoverable zinc, valued in all at $560,463, or $44.44 a ton. The output of the district was valued at $745,748 in 1920. The greater part of the ore, or 9,540 tons, was shipped directly to smelters. The Philipsburg Mining Co. shipped a large quantity of siliceous silver ore and also much ore containing silver, lead, and zinc, which was concentrated at Anaconda. Pyrargyrite is a familiar mineral of the district, but the zinc blende has only recently become a commercial product. The next largest producer of siliceous silver ore was the Granite-Bimetallic mine. Other producers of note were the Headlight, Young America, McKay, Scratchall, Sweet Home, and Two Percent properties.

Henderson district.—A clean-up of silver bullion was made at the Windfall property.

Moose Lake district.—Ore from the Banner Mines (Inc.), operating property on the Middle Fork of Rock Creek, yielded a pyrite concentrate containing gold and silver which was shipped to East Helena.

Red Lion district.—A test lot of lead ore was shipped from the Little Mae mine.

South Boulder district (*Maxville*).—Three deep mines in the South Boulder district produced 148 tons of ore, containing $431 in gold, 14,559 ounces of silver, 4,297 pounds of copper, and 29,248 pounds of lead, valued in all at $16,860, or $113.92 a ton. The only important producer was the Moonlight mine, from which sulphide lead ore rich in silver was shipped.

JEFFERSON COUNTY.

Mine production in Jefferson County, Mont., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	74	39,170	$80,821	480,850	256,044	3,414,357	40,460	$928,484
1921	76	16,192	40,440	113,744	23,947	817,266	.....	194,050
Increase or decrease, 1921	+2	−22,978	−40,381	−367,106	−232,097	−2,597,091	−40,460	−734,434

[a] Includes placer production.

The value of the output of Jefferson County decreased nearly 80 per cent, on account of the idleness of many old producers in the Cataract and Colorado districts.

Amazon district.—Small shipments of ore were made from the Emma May and Montana properties, and lead slag was shipped from the Amazon dump.

Bigfoot district.—Several lots of gold ore were shipped from the State group, near Boulder.

Boulder district.—Two deep mines and two placers in the Boulder district produced 113 tons of ore, $499 in gold, 1,838 ounces of silver, 1,619 pounds of copper, and 8,549 pounds of lead, valued in all at $2,931. The Lulu placer, on Wilson Creek, was operated five months. The Baltimore property produced several shipments of both silver ore and sulphide lead ore.

Cataract district (Basin).—Twenty-three deep mines and one placer in the Cataract district produced 1,661 tons of ore, $8,269 in gold, 37,065 ounces of silver, 14,402 pounds of copper, and 164,609 pounds of lead, valued in all at $54,599, or $32.87 a ton. Several hundred tons of silver ore, copper ore, and sulphide lead ore were shipped from the Crystal mine. The Obelisk mine, near Basin, shipped rich silver ore, and the Comet and Grey Eagle mines shipped lead ore and silver ore. Other shipments of note came from the Bullion, West Rumley, Jennie B., Buckeye, Minneapolis, and Garfield properties. Some of the prominent ore minerals are chalcopyrite, tetrahedrite, galena, sphalerite, pyrite, and arsenopyrite. In 1920 the output of the Cataract district was valued at $341,924, largely from the Crystal and Comet mines.

Colorado district (Wickes).—Seventeen deep mines in the Colorado district produced 5,724 tons of ore, containing $2,885 in gold, 30,504 ounces of silver, 6,217 pounds of copper, and 522,377 pounds of lead, valued in all at $57,698, or $10.08 a ton. In 1920 the output was valued at $315,624. Most of the output, or 4,726 tons, was old slag resmelted. The remainder, 998 tons, was crude ore shipped to the smelter. The largest production of first-class ore came from the Mount Washington mine, owned by the Angelica Mining & Development Co., which produced sulphide lead ore. This ore is hauled 2 miles to Wickes, on the Great Northern Railway. The mine was operated only three months under lease. Shipments also came from the Alta Montana, Alta Gregory, Blue Bird, Mayflower, Minah, Stegmiller, and Pen Yan properties.

Elkhorn district.—Five deep mines and one placer in the Elkhorn district produced 8,061 tons of ore, $24,750 in gold, 15,929 ounces of silver, and 44,404 pounds of lead, valued in all at $42,677, or $5.29 a ton. The East Butte Copper Mining Co. operated the Swissmont mine and treated gold ore in the 150-ton cyanide plant. The ore is of low grade, and the company has been waiting several years for costs to decrease so that operations could be resumed on a paying basis. The ore, which occurs in a contact deposit between limestone and diorite, contains various iron and copper minerals. Fluxing iron ore containing gold was shipped from the Golden Curry mine, formerly a large producer. The Western Metallurgical Co. (Ltd.) operated the old tailings dump at Elkhorn and produced some gold and silver bullion by cyanidation. The Summit mine, near Finn, produced several lots of lead ore containing gold and silver.

Golconda district.—The Hie Ore and Buckhorn properties produced several lots of lead ore from Golconda Creek, south of Prickly Pear Creek, southeast of Jefferson City.

Homestake district.—A test lot of silver ore was shipped from the Emma mine.

Lump Gulch district (Clancey).—Eight deep mines and one placer in the Lump Gulch district produced 416 tons of ore, $1,281 in gold, 23,622 ounces of silver, 62 pounds of copper, and 36,946 pounds of lead, valued in all at $26,574, or $62.49 a ton. The Liverpool mine was operated by the Mines Corporation of Montana and produced several hundred tons of oxidized lead ore containing much silver. Ore was also shipped from the Amalgamated Silver, Mammoth, Little Nell, Argonaut, and Margaret properties. Placer bullion was shipped from the Botkin lease, 9 miles from Clancey.

Pipestone district.—One lot of siliceous silver ore was shipped from the Mountain Gem property.

Whitehall district.—The Pioneer mine produced one shipment of silver ore.

JUDITH BASIN COUNTY.

In 1921 the western part of Fergus County and the eastern part of Cascade County were made into Judith Basin County. It includes the Barker district, at Hughesville, east of Monarch.

Barker district (Hughesville).—Seven deep mines in the Barker district produced 4,923 tons of ore, containing $2,607 in gold, 97,342 ounces of silver, 943 pounds of copper, and 1,712,153 pounds of lead, valued in all at $177,118, or $35.98 a ton. Most of the output came from the Wright & Edwards property, operated by the Block P. Mining Co. The 100-ton concentration mill was active two months, and a large quantity of lead ore and concentrate was hauled to Monarch, 14 miles from the mine, and then shipped to East Helena. The mine is opened by a shaft 400 feet deep and drifts 1,800 feet long. Other shipments were made from the Liberty, Big Four, Sampson, August, and Emerald properties. The ore contains several sulphides of copper, lead, zinc, and iron.

Yogo district.—The Blue Bell mine produced a small test lot of lead ore.

LEWIS AND CLARK COUNTY.

Mine production in Lewis and Clark County, Mont., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
Placers:							
1920	14	.....	$2,412	22	.....	.....	$2,436
1921	17	.....	4,806	65	.....	.....	4,871
Deep mines:							
1920	40	53,252	332,624	85,520	12,054	829,987	494,458
1921	36	49,864	371,779	44,619	5,973	434,788	436,735
Increase or decrease, 1921	−1	−3,388	+41,549	−40,858	−6,081	−395,199	−55,288

The ore mined in Lewis and Clark County decreased more than 6 per cent in 1921, and most of it was treated in milling plants by cyanidation. The increase in the output of gold only partly offset a large decrease in silver and lead. Smelting of lead ores was continued at East Helena, Mont., throughout the year, and the plant

received much ore from Butte and other camps after the smelter at Anaconda was closed.

Bald Butte district (Marysville).—The Tower & Templeman Leasing Co. treated by cyanidation a large quantity of old tailings from the Bald Butte dump.

Dry Gulch district.—Six placers in the Dry Gulch district produced $2,221 in gold and 17 ounces of silver. Most of the production came from the Jim Town, Producer, and Kingsbury Gulch properties.

Grass Valley district.—Four deep mines in the Grass Valley district produced 210 tons of ore, containing $134 in gold, 9,153 ounces of silver, and 1,722 pounds of lead, valued in all at $9,364, or $44.59 a ton. A large part of the ore was mined from the Nora Darling and Gray Eagle properties and shipped from Rheems Spur.

Heddleston district.—One shipment of oxidized copper ore was made from the Anaconda property.

Helena district.—Three deep mines and three placers in the Helena district produced ore and bullion valued at $2,607. Several lots of lead ore were shipped from the Helena mine.

Lincoln district.—The Sterling Mining & Milling Co. operated the Mike Horse mine and treated much lead ore in a 100-ton concentration plant. Concentrates were shipped from Silver, on the Great Northern Railway. The Harvey placer was operated two months.

Ottawa district (Marysville).—Nine deep mines and one placer in the Ottawa district produced 38,154 tons of ore, $356,004 in gold, 16,582 ounces of silver, 3,062 pounds of copper, and 54,329 pounds of lead, valued in all at $375,426, or $9.84 a ton. The largest producer was the Barnes King Development Co., which operated the Shannon mine throughout the year. The company's report [5] says:

> There was no production from the Piegan-Gloster mine, but the mill was operated steadily, treating ore from the Shannon mine, delivery being made by aerial tramway 2½ miles long. * * *
>
> Production of the Shannon mine was 36,570 dry tons, of an average assay value at the mine of $9.74 per ton.
>
> The above tonnage of ore came from the 400, 500, and 600 levels, the upper levels being nonproductive.
>
> The principal ore development of the year was the opening of a hanging-wall shoot on the 600 level, with a length of 200 feet, width 6 feet, and an indicated value of $8.56 per ton. This shoot is 800 feet west of the working shaft and gives promise of going down. To prove this, a winze was started in December and sunk 25 feet and will be carried to the 700 level. * * *
>
> Development work for the year amounted to 3,311 feet. * * * In addition, 505 feet of development work was done on the Black Hawk claim.
>
> The estimated ore in sight January 1, 1922, was 16,860 tons of an indicated value of $9.95 per ton.

The profit from the operation of the Shannon mine was $82,445, but no dividends were paid.

Several hundred tons of rich gold ore was shipped from the old Drumlummon mine, and some dump material was treated by cyanidation. The Cruse & Bald Mountain property and the Philadelphia Mining Co. were also large producers.

Scratch Gravel district.—Five deep mines and one placer in the Scratch Gravel district produced 137 tons of ore, $1,996 in gold, 3,735 ounces of silver, 777 pounds of copper, and 38,437 pounds of lead, valued in all at $7,561, or $55.06 a ton. Crude shipping ore was mined at the Franklin, Silver Coin, and West Side group.

[5] Barnes King Development Co. Ann. Rept. for year ending Dec. 31, 1921.

Seven Mile district.—Several cars of dump ore containing silver were shipped from the Saginaw and Silver King properties.

Stemple district.—The Bell Boy and Klondyke mines produced some ore which was treated by amalgamation.

Springhill district.—Two placers were operated on Skelly Gulch.

Unionville district.—Ore was treated by amalgamation and concentration at the Yellow Jacket and Whitlatch properties. The Whitlatch mine was idle with the exception of a general clean up.

Vaughn district (Rimini).—Seven deep mines and two placers in the Vaughn district produced 109 tons of ore, $2,483 in gold, 4,179 ounces of silver, 358 pounds of copper, and 17,662 pounds of lead, valued in all at $7,503 or $53.79 a ton. Gold and silver bullion was recovered by hydraulic mining at the Perseverance placer. Shipments of ore were made from the Matt Carroll, Peerless Jennie, Nick, San Juan, and Sallie Bell properties.

LINCOLN COUNTY.

Libby district.—The Lukens Hazel mine, near Libby, which is equipped with a 200-ton concentration-flotation mill, was operated about half the year and shipped concentrate to the East Helena smelter. The mine is opened by an inclined shaft 330 feet deep and 5,000 feet of drifts. At the Nome property gold ore was tested in an arrastre. The Comet Placer Co., 20 miles southeast of Libby, produced some gold while doing assessment work.

Tobacco River district.—A little placer gold was produced near Eureka, on Tobacco River.

Troy or Callahan Creek district.—The Snow Storm Mines Consolidated, 6 miles from Troy, produced ore containing lead and zinc which was milled in a 500-ton concentration-flotation plant. Practically all the output in 1921 was lead concentrate shipped to the Bunker Hill smelter at Bradley, Idaho. The mine was operated only part time, and the production was comparatively small.

MADISON COUNTY.

Mine production in Madison County, Mont., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
Placers:							
1920	6	.....	$256,307	2,001	.....	.....	$258,488
1921	5	.....	191,121	1,354	.....	.....	192,475
Deep mines:							
1920	49	4,637	72,818	34,913	4,272	287,408	134,652
1921	57	16,241	244,342	45,469	30,729	540,506	318,098
Increase, 1921	7	11,604	106,338	9,909	26,457	253,098	117,433

The production of gold in Madison County increased $106,338, in spite of the decrease of $65,186 in placer gold.

Alder Gulch district (*Virginia City*).—Six deep mines and two placers in the Alder Gulch district produced 4,420 tons of ore, $230,514 in gold, 22,746 ounces of silver, 510 pounds of copper, and 20,727 pounds of lead, valued in all at $254,259, or $14.13 a ton. The placer output was $190,454 in gold and 1,345 ounces of silver. The

Conrey Placer Mining Co., near Ruby, operated the entire year and made a large but decreased production of gold. More than 4,000,000 cubic yards of gravel was treated by dredge operations. The company is still one of the largest gold producers in the State in spite of the fact that its ground is said to be nearly worked out. At the Barton Gulch and Greenback properties ore was milled and rich concentrates containing gold and silver were shipped to East Helena. Other producers in the district were the U. S. Grant, Native Silver, and Monte Cristo properties.

Bone Basin district.—The Florence Mining Co., operating near Renova, shipped lead ore containing considerable gold.

Lower Hot Springs district (Norris).—Six deep mines in the Lower Hot Springs district produced ore valued at $2,895, or an average of $33.66 a ton. The largest producer was the Evergreen & Madisonian property, from which rich gold ore was shipped.

McCarthy district.—The Polly Jane mine produced one lot of oxidized lead ore, and the Hidden Treasure property some unusually rich gold ore.

Mineral Hill district (Pony).—Three deep mines and one placer in the Mineral Hill district produced 310 tons of ore, $2,547 in gold, and 113 ounces of silver, valued in all at $2,660. The largest output came from the Boss Tweed mine, where gold ore was treated by amalgamation.

Rabbit district (Rochester).—The Pete & Joe mine, near Twin Bridges, produced several hundred tons of ore containing about 3 ounces of gold to the ton.

Ramshorn district (Laurin).—Three deep mines in the Ramshorn district produced 88 tons of ore, which had a gross value of $4,154. Several shipments of rich silver ore were made from the Silver King property.

Sheridan district.—Seven deep mines and two placers in the Sheridan district produced 681 tons of ore, $9,387 in gold, 456 ounces of silver, and 203 pounds of copper, valued in all at $9,869. Most of the production was that of the Tamarack group, at which several hundred tons of ore was treated by amalgamation. At the McKay placer, in Bevins Gulch, stream gravel and old tailings were treated by sluicing.

Silver Star district.—Eight deep mines in the Silver Star district produced 187 tons of ore, containing $3,086 in gold, 2,946 ounces of silver, 10,059 pounds of copper, and 25,871 pounds of lead, valued in all at $8,493, or $45.42 a ton. All the ore was shipped directly to smelters. Rich gold ore was shipped from the Edgerton mine, and other producers were the Broadway, Emma, Victoria, and Wheal Clifford.

Summit district (Virginia City).—One lot of silver ore was shipped from the Homestake property, and gold ore from the Mountain Flower mine was treated by amalgamation and concentration.

Tidal Wave district (Twin Bridges).—Eleven deep mines in the Tidal Wave district produced 137 tons of ore, containing $4,439 in gold, 1,302 ounces of silver, 1,712 pounds of copper, and 35,583 pounds of lead, valued in all at $7,563, or $55.20 a ton. All the ore was first-class shipping ore and consisted of small lots from the Corn Cracker, Ella, Lottie, A. P. A. Extension, Sunflower, Texas, Wild Cat, and Lucky Boy claims.

Upper Hot Springs district.—With the exception of small test shipments the output of the Upper Hot Springs district was gold and silver bullion from the operations of the Revenue Mines (Inc.), at Norris, where ore was treated by cyanidation.

Washington district.—A small quantity of ore was treated by amalgamation at the Lehigh mine, and several thousand tons was treated by cyanidation and concentration by the Missouri Mining Co. The mine is 15 miles from Norris.

Unorganized district.—Several lots of gold and silver ore from the Mayflower mine were shipped from Renova.

MEAGHER COUNTY.

Beaver Creek district.—The Klondyke placer, 7 miles from Watson, produced placer gold by sluicing.

MINERAL COUNTY.

Cedar Creek district (*Iron Mountain, Quartz*).—One deep mine and seven placers in the Cedar Creek district produced gold valued at $7,734 and 12 ounces of silver. The Cedar Creek, Meadow Creek, Mildred, Ohio Gulch, Stockholm, C. B. & Q., and Windfall placers were active producers.

Iron Mountain district.—One lot of sulphide lead ore containing silver was shipped from the Iron Mountain Tunnel property.

St. Regis district.—Though no shipments were made from the St. Lawrence mine, it is said to have opened a good grade of sulphide copper ore.

MISSOULA COUNTY.

Coloma district.—Placer operations on Quartz Creek resulted in the production of gold and silver valued at $866 from the Davey and Elk Creek Hydraulic properties.

Ninemile district.—Six placers in the Ninemile district produced gold valued at $1,348 and 2 ounces of silver. The Boyd, Chrysalis, Marion Creek, Petty Creek, and San Pit placers were operated a short time.

Wallace district.—The Cape Nome property, 4 miles from Clinton, produced several shipments of sulphide copper ore.

Unorganized district.—One shipment of lead ore was marketed from the Katie mine, near Nimrod.

PARK COUNTY.

Emigrant district.—Three placers in the Emigrant district produced $928 in gold and 7 ounces of silver. The Chico property, near Emigrant, was operated by drift mining.

New World district (*Cooke*).—No ore was shipped from the New World district, but the general conditions were given in a recent article.[6] Development of the Scotch Bonnet mine was continued by the Glengarry Mining Co.

[6] Brooks, L. H., Cooke City and the New World district: Min. and Sci. Press, May 14, 1921, p. 682.

Sheepeater district (Jardine).—The Jardine Gold Mining & Milling Co., formerly a large producer of gold, was idle during 1921, which accounts for the large decrease in the gold output of Park County.

POWELL COUNTY.

The value of the metal output of Powell County increased $10,327 in 1921.

Big Blackfoot district.—A good production of placer gold resulted from operations at the Gold Dust property, on Ogden Mountain, near Helmville.

Nigger Hill district.—One lot of sulphide lead ore was shipped from the Carbonate Boy mine, near Elliston.

Ontario district (Elliston).—Five deep mines and two placers in the Ontario district produced 562 tons of ore, $16,024 in gold, 8,877 ounces of silver, 1,380 pounds of copper, and 127,650 pounds of lead, valued in all at $30,823, or $54.55 a ton. The ore came principally from the Big Dick, Charter Oak, and Monarch properties. The Evening Star Development Co., operating the Big Dick mine, shipped several hundred tons of sulphide lead ore that was unusually rich in both gold and silver.

Ophir district (Finn).—The output of the Ophir district from five deep mines and two placers was valued at $729 and consisted of small test lots from several prospects. The Prairie & Carpenter Bar placer, near Ophir, was active four months.

Pioneer district (Gold Creek).—Four placers and one deep mine in the Pioneer district produced $4,274 in gold, 83 ounces of silver, and 104 pounds of lead. A large part of the gold came from the Friday placer, on Gold Creek. Placer operations were also carried on at the Pioneer, Upper Gold Creek, and Christian properties.

Washington Gulch district.—Placer gold was mined from the Fontana and Keiley placers, near Finn.

Zozell district.—The Blue Eyed Maggie property produced one lot of silver ore, and the Sterritt mine one lot of lead ore.

Unorganized district.—The North Pole property produced two shipments of silver ore.

RAVALLI COUNTY.

Hughes Creek district.—The output of gold and silver in the Hughes Creek district was valued at $2,211, principally the result of placer operations of the Hughes Creek Hydraulic Co. and the Hughes Creek Dredging Co.

SANDERS COUNTY.

Perma district.—One shipment of copper ore was produced from the Chilson property.

Thompson River district.—One shipment of lead ore was made from the Silver King mine, near Woodland.

SILVER BOW COUNTY.

Mine production in Silver Bow County, Mont., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	103	5,013,847	$647,013	10,575,894	176,403,808	17,590,182	183,812,943	$60,929,101
1921	61	1,141,013	283,502	4,983,972	47,957,949	13,241,497	22,901,059	13,194,969
Decrease, 1921	42	3,872,834	363,511	5,591,922	128,445,859	4,348,685	160,911,884	47,734,132

[a] Includes placer production.

Most of the ouput of Silver Bow County in 1921 was produced by five companies. A decrease in output of all metals is shown in the accompanying table. The largest part of the ore produced was concentrated at milling plants at Butte and Anaconda. The product consisted of copper concentrates, zinc concentrates, lead-zinc concentrates, lead concentrates, and siliceous concentrates, valued in all at $10,091,746, or $49.32 a ton. The crude smelting ore had an average value of $25.38 a ton. No ore was treated in gold and silver mills, but 148,900 tons of old tailings was leached with sulphuric acid, and 250,390 tons of slag and tailings were milled or smelted. Of the total output of ore about 81 per cent was classified as copper material.

Divide Creek district (Melrose).—Seven deep mines in the Divide Creek district produced 118 tons of ore, containing $296 in gold, 3,654 ounces of silver, 232 pounds of copper, and 13,786 pounds of lead, valued in all at $4,600, or $38.98 a ton. The largest shipments came from the Climax, Bryan, Gray Rock, and Superior mines.

German Gulch district.—The Beal placer, in German Gulch, produced gold bullion by the hydraulic method.

Summit Valley or Butte district.—Fifty-one deep mines in the Butte district produced 1,140,895 tons of ore and old tailings, containing $280,085 in gold, 4,980,285 ounces of silver, 47,957,717 pounds of copper, 13,227,711 pounds of lead, and 22,901,059 pounds of recoverable zinc, valued in all at $13,187,215, or $11.56 a ton. Most of the ore, or 662,661 tons, was reduced to 204,629 tons of concentrates, 78,936 tons was shipped directly to smelters, and the remainder was old tailings leached and old slag and tailings resmelted. In 1920 the output was valued at $60,919,057. The unusual decrease was due to the idleness of some of the Butte mines the greater part of the year.

From the beginning of activities in 1882 to the end of 1921 Silver Bow County, of which this district covers the largest part, has produced gold, silver, copper, lead, and zinc valued at $1,694,365,138, as follows: Gold, $31,802,260; silver $266,569,844; copper, $1,252,484,423; lead, $7,315,787; and zinc, $136,192,824. The production of zinc began in 1905. The values given above are for 1,538,434.29 ounces of gold, 365,708,847 ounces of silver, 7,987,032,423 pounds of copper, 118,054,839 pounds of lead, and 1,489,927,945 pounds of recoverable zinc.

The mines of the Anaconda Copper Mining Co.[7] produced 413,300 tons of ore and 8,116 tons of precipitates, a total of 421,416 tons in 1921, against a total of 2,160,320 tons in 1920. The copper-reduction works treated for all companies 456,493 tons of ore and other cupriferous material at Anaconda. No copper ores were treated at Great Falls except a small quantity of copper concentrates from Anaconda used for fluxing the zinc plant residues. Of the material treated at Anaconda 395,239 tons of ore was produced by company mines, 54,200 tons was either purchased from or treated for other companies, and 7,054 tons came from the old plants at Anaconda and Butte. The Anaconda works produced 36,257,591 pounds of fine copper, 2,269,875 ounces of silver, and 8,725.89 ounces of gold, and a large part of this output came from the mines of the Anaconda Co. The electrolytic copper refinery at Great Falls produced 41,842,790 pounds of cathodes, which were melted into shapes at Great Falls. The copper-leaching plant at Anaconda treated 148,900 tons of tailings, from which 842 tons of cement copper was produced. The zinc plants at Anaconda and Great Falls treated 126,515 tons of ore and other zinciferous material, of which 76,435 tons was produced by mines of the Anaconda Co. and 50,079 tons of ore and concentrates was purchased from other companies. The plant at Great Falls produced 22,684,264 pounds of electrolytic zinc, 622,273 pounds of zinc in dross, and residue which contained 12,008,332 pounds of lead, 1,312,379 pounds of copper, 2,055,939 ounces of silver, and 5,268.76 ounces of gold. The total production of rods for the year was 42,435,436 pounds. Of this quantity 17,635,512 pounds was manufactured into wire, of which 12,393,221 pounds was made into strand. No dividends were paid in 1921 by the Anaconda Co. The company report continues:

> An available supply of copper far in excess of the demand for consumption resulted in the demoralization of the industry during the year 1921.
>
> The industrial depression that had become acute in the last quarter of 1920, continued beyond the first of the year, resulting in a greatly restricted demand. The surplus stocks resulting from the sudden termination of the war, and which had been carried over, showed no substantial decrease during the year, as production had been maintained at a level about equal to current consumption. Quantities of copper and brass scrap continued to be marketed. The result was a rapid increase during the first quarter, of refinery stocks.
>
> The market price for the metal declined to less than 12 cents a pound, while the cost of production remained relatively high, due to prevailing wages, freight rates, and the cost of supplies.
>
> To meet the situation a suspension of operations was unavoidable, and accordingly the company's production ceased about April 1, the mines remaining closed to the end of the year. * * *
>
> Under these conditions it was impossible to avoid sustaining a heavy loss during the year. The aggregate of all items entering into the profit and loss statement is $16,999,555. * * *
>
> Convinced that in order to protect the business of the company, it should be placed in a position to control the outlets of its metals and to promote the sale and distribution of copper and brass products, negotiations were initiated for the purchase of the shares of the American Brass Co.

From the North Butte property[8] 24,755 dry tons of ore was treated at the smelter at Anaconda. Of this ore, 23,598 tons, or 95.3 per cent, was second class, and 1,157 tons, or 4.7 per cent, was third class. The production was 1,229,600 pounds of fine copper, 34,536 ounces of silver, and 78.04 ounces of gold. The report continues as follows:

[7] Anaconda Copper Mining Co. Ann. Rept. for year ending Dec. 31, 1921.
[8] North Butte Mining Co. Ann. Rept. for year ending Dec. 31, 1921.

Mining was continued at about one-fourth normal capacity from the beginning of the year until March 23, when due to the badly demoralized condition of the copper metal market, production was suspended. Nearly all of the copper producers of this country followed the same policy, resulting in a quite general suspension which was still in force at the end of the year.

Development work, however, has been continued on the deeper levels of the mine, although on a curtailed basis. A total of 11,313 feet was driven in the Granite Mountain mine as compared with 19,100 feet driven in 1920. * * *

Mining costs have been considerably lowered. Wage adjustments were necessary to bring costs down to a reasonable basis, since labor constitutes about two-thirds of the cost of production.

Gross income was $96,097 and expenditures $422,673, including $211,576 for mining and development, $4,985 for freight on ore, $88,351 for concentrating, smelting, refining, and selling, and $117,761 for general expenses and taxes.

The East Butte Copper Mining Co.[9] operated the 500-ton copper smelter and 1,200-ton concentration-flotation plant east of Butte. The mine and smelter were in operation full time. The mill and smelter treated 85,009 tons of company ore and 66,123 tons of custom ore, producing 990 ounces of gold, 508,680 ounces of silver, and 14,766,017 pounds of copper, a decrease in the copper output of more than 20 per cent from that of 1920. The gross value of the metals shipped was $2,413,119. No dividends were paid in 1921. The price received for copper was 12.50 cents a pound, and the cost of production was 11.28 cents a pound. The report continues:

Coke and powder, two large items of cost, have not receded at all from war-time prices. Other supplies have receded but comparatively little, and labor has receded somewhat less than 50 per cent of war-time advances, while freight rates during the year were at the peak of post-war advances.

The average assay value of ore mined during the year was 4.88 per cent, as against 4.02 per cent for 1920, and 3.71 per cent for 1919. This higher average value has been due to more efficient sorting of ore rather than to working higher-grade ore bodies. * * *

Development for the year consisted of 4,146 feet of drifts and crosscuts and 1,284 feet of upraises. As a result of this work, ore bodies in the lower levels of the mine have been extended and enlarged so that new ore developed has quite offset that which has been removed during the year. In the meantime, exploration on the higher levels of the mine has resulted in opening an ore body of very promising proportion and values on a vein that has been worked in the Tropic and Main Range mines adjoining to the east and there referred to as the Spread Delight vein. This vein was worked in the Tropic mine to the edge of the property and is known to contain workable values where it crosses the line into the Pittsmont property. From this point to the point where it has been developed in the Pittsmont property is 1,100 feet, and from the latter point to the opposite side of the property is 400 feet. The vein therefore crosses the property for a distance of 1,500 feet. The Pittsmont property lies between the Tropic and Main Range mines and the main producing area of the camp. In view of conditions described, it is believed that this development is of far-reaching consequence and promises important extensions of ore reserves. Ores from this vein carry a percentage of silver values considerably higher than those from veins farther south.

In addition to the exploration and development work * * * regularly prosecuted to maintain ore reserves, a new working shaft known as No. 4 has been completed. This shaft had been upraised from the 1,800 to the 800 level in 1918, and was extended from the 800 to the surface, a distance of 731 feet during the latter part of the past year.

The Tuolumne Copper Mining Co.[10] produced from the Main Range mine during the first three months of the year 3,818 dry tons of ore which had an average assay of 0.0075 ounce of gold, 8.258 ounces of silver, and 2.960 per cent of copper. The metal contents were 29.82

[9] East Butte Copper Mining Co. Ann. Rept. for year ending Dec. 31, 1921.
[10] Tuolumne Copper Mining Co. Ann. Rept. for year ending Dec. 31, 1921.

ounces of gold, 32,829 ounces of silver, and 235,347 pounds of copper, for which the company received $30,021 from the smelter. The printed report continues:

The total operating expense for the year amounted to $151,794.97; of this amount $26,624.24 was charged to mining, $83,754.51 to development, $7,036.88 to repairs and alterations, $31,242.64 to general office, freight, hauling, insurance, taxes, and interest, $2,647.08 to equipment and maintenance of equipment, and $389.62 to construction and maintenance of construction. * * *

Development work consisted of 2,227 feet and was prosecuted during the entire year as vigorously as conditions would permit. Shaft sinking which was resumed in December, 1920, was continued until April, 1921, when the 1,600-foot level was reached. On the 1,600-foot level a station was cut and a crosscut driven south from the station to the Spread Delight vein. The vein where penetrated by the crosscut was found to be over 100 feet in width, consisting of a number of parallel fissures highly mineralized but not of commercial value at this point. A drift was extended easterly encountering some ore of fairly good grade, the best of which, however, occurred along the bottom of the drift. A drift was also extended westerly from the main crosscut and some high grade copper-silver ore encountered in this working.

The Butte & Superior Mining Co. shipped no ore or concentrate in 1921, but development work was continued. The net current assets of the company [11] at the end of the year were $2,023,295 after deducting expenses of $1,039,184. The report continues:

The estimated developed ore reserves as at December 31, 1921, amounted to 484,507 tons, as compared to 422,100 tons at December 31, 1920. In addition to this tonnage there is a fully blocked reserve of over 300,000 tons of lower grade ore which is not included in the above because its metal contents are not sufficient to justify mining and milling it at prevailing costs of operations and prices for metals.

The outstanding result of the development work done during the year was the discovery of good copper ore in a large vein which was first encountered on the 2,000 level, then on the 2,200 level, and since the close of the year on the 2,600 level. The ore occurrence was small and erratic where first disclosed, but on the 2,200 level it has been opened up for a length over 330 feet east and west and is still continuing in both directions. The width on this level averages 7½ feet and the grade averages slightly under 6 per cent copper and about 8 ounces of silver per ton. On the 2,600 level the vein where crosscut is much wider and the values continue good. * * *

Toward the end of the year a turn for the better was apparent both as to metal stocks and prices, and your board, believing that the worst of the depression had passed undertook negotiations which shortly after the close of the year culminated in a contract with the Anaconda Copper Mining Co., under which that company purchases the concentrates resulting from the treatment of 1,000 tons of ore per day and operations on that basis were resumed in January. The margin of profit from such operations will be small until there is further advance in the price of zinc, but in the meantime heavy shutdown expenses and losses will be avoided. * * *

The year's development work consisted of 3,920 feet of drifting, 2,678 feet of crosscutting, 53 feet of raises, 471 feet of station cutting, and 226 feet of shaft sinking, or a total of 7,448 feet exclusive of 313 feet of diamond drilling.

The Emma mine, owned by the Butte Copper & Zinc Co.[12] and leased to the Anaconda Copper Mining Co., was idle most of the year. The pumps have been kept going and the property is in excellent physical condition and in shape to resume operations at a moment's notice. The net loss for the year was $61,075.

The Elm Orlu mine was active the entire year. Lead-zinc ore was milled at the Timber Butte mill, south of Butte, about three months and the concentrate shipped to Great Falls. Later in the year a large deposit of silver-lead ore was said to have been opened on the 800-foot level, and the mill again operated to make a lead concentrate which was smelted at East Helena. Much first-class silver ore was also shipped. Though the production of zinc was small

[11] Butte & Superior Mining Co. Tenth Ann. Rept., for year ending Dec. 31, 1921.
[12] Butte Copper & Zinc Co. Ann. Rept. for year ending Dec. 31, 1921.

compared with past years, the production of silver was close to that of 1920.

The Davis-Daly Copper Co. operated the Colorado mine, in the center of the city of Butte, and the Hibernia mine, 2 miles west of Butte. The production of copper ore from the Colorado mine, about 60 per cent of that of 1920, was shipped to the East Butte smelter, and part of it was milled at Pittsmont prior to smelting. The mine, which has a shaft 2,800 feet deep and 78,887 linear feet of raises, drifts, and crosscuts, was operated until November 19, 1921. The output from the Hibernia mine was greatly increased. Silver ore was shipped to East Helena, and lead-zinc ore, rich in silver, was milled at Anaconda. The mine is opened by a vertical shaft 750 feet deep and 21,450 feet of raises, drifts, and crosscuts. The fiscal report of the company [13] contains the following paragraphs:

> The entire developments completed during the fiscal year, both by leasers and by the company, on all Davis-Daly properties are shown by the following summary: Shaft sinking 445 feet, crosscuts 5,676 feet, drifts 5,041 feet, raises 5,528 feet, stations 14 feet, and winzes 98 feet. The foregoing shows an addition of 3.20 miles of underground workings and developments in the Colorado mine show ore reserves amounting to 337,316 tons.
>
> One of the principal developments in the Colorado mine, during the year, was the completion from the surface to a depth of 1,800 feet of an octagonal ventilation shaft having a minimum inside diameter of 6½ feet, together with the necessary crosscuts and stations to connect the same with the various levels in the mine, including the work of retimbering and repairing a number of existing crosscuts and raises to make the ventilation circuit complete. * * *
>
> Other developments, in addition to disclosing large ore bodies on the 2,700 level, were successful in opening up several good commercial ore bodies on higher levels. The amount of ore developed during the year was approximately 62,000 tons in excess of the amount mined out, so that the reasonably assured reserve of the property at the end of the period is greater than that at the beginning of the year. * * *
>
> The sinking of the Hibernia shaft from the 400 to the 600 level was completed on August 5, 1920. Since completion, the shaft station, pump station, and 2,679 feet of raising, drifting, and crosscutting have been completed from the 600 level. This work resulted in the development of a considerable tonnage of silver-zinc-lead ore, from which a large and profitable production has been maintained. Substantial additions to this tonnage were made from the operations of the 400 and higher levels. * * *
>
> Production of ore from all properties of the company for the fiscal year amounted to 128,960 tons, producing 8,456,062 pounds of copper, 1,463,182.452 ounces of silver, 2,608.214 ounces of gold, 2,127,290 pounds of lead, and 5,060,368 pounds of zinc.

The Anselmo mine was in operation throughout the year and shipped during May, June, July, and August. The ore is concentrated at Anaconda and the concentrate leached at Great Falls. The Goldsmith mine, operated by the Crystal Copper Co., was an important producer of ore containing gold and silver. The Moulton mine was operated by lessees and produced silver ore and ore which was milled at Anaconda to save the lead and zinc. Other important producers of silver ore were the Uncle Sam, Garfield Salvador, Poser, Amy, Brilliant, and Travona mines.

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[13] Davis-Daly Copper Co. Ann. Rept. for year ending June 30, 1921.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA.

(MINES REPORT.)

By V. C. Heikes.[1]

PRODUCTION.

STATISTICAL SUMMARY.

Curtailment of production continued at the mines in Arizona, and the output in 1921 was considerably less than that of 1920. Nearly all the copper mines and smelters operated until April, after which they stopped production owing to the reduced consumption of copper and consequent low prices for the metal. Dividends were paid to stockholders by the Miami Copper, United Eastern, United Verde, United Verde Extension, and Calumet & Arizona mining companies, amounting to $5,997,071. The Phelps Dodge Corporation, operating mines at Bisbee and also in Mexico and New Mexico, paid $1,850,000, which is not included in the total given above.

The output of all metals produced in Arizona decreased considerably in both quantity and value. The average value of the ore decreased from $7.68 a ton in 1920 to $5.42 in 1921, but the gold and silver value per ton increased from 71 to 99 cents.

Mine production of gold, silver, copper, lead, and recoverable zinc in Arizona in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	318	14,920,478	$4,786,122	5,355,303	558,256,302	14,599,765	1,457,296	$114,628,584
1921	215	5,455,030	2,930,303	2,469,394	185,034,194	6,541,433	.....	29,563,472
Decrease, 1921	103	9,455,448	1,855,819	2,885,909	373,222,108	8,058,332	1,457,296	85,065,112

[a] Includes placer production.

[1] Valuable assistance in the preparation of the report and the compilation of the statistical tables was rendered by B. N. Patchell, of the United States Geological Survey.

Ore sold or treated, number of deep mines producing, and average value of ore per ton in Arizona in 1920 and 1921.

County.	Ore sold or treated, 1921 (short tons).		Number of deep mines producing.		Average total value per ton. [a]		Average value per ton in gold and silver. [a]	
	Total.	Decrease.	1920	1921	1920	1921	1920	1921
Cochise	444,122	1,097,358	44	29	$17.23	$15.59	$2.23	$4.16
Coconino		114	2		23.23		.95	
Gila	2,872,471	4,542,581	36	32	4.58	3.54	.11	.09
Graham	8	1,720	3	1	18.90	24.38	5.98	21.12
Greenlee	389,981	645,889	10	6	6.58	3.96	.23	.18
Maricopa	763	32	11	6	32.78	14.97	15.03	13.10
Mohave	191,867	11,291	34	20	15.14	13.34	14.83	13.25
Pima	929,455	847,854	35	13	4.68	2.83	.02	
Pinal	430,943	1,400,733	30	15	6.05	4.02	.32	.50
Santa Cruz	1,013	10,574	26	16	34.60	33.52	10.13	15.88
Yavapai	191,964	846,279	67	33	22.77	20.45	2.26	2.55
Yuma	2,413	61,023	12	7	10.94	11.38	.24	1.50
	5,455,030	9,465,448	310	178	7.68	5.42	.71	.99

[a] Placer product excluded.

Mine production of gold, silver, copper, and lead in Arizona in 1921.

County.	Gold.					Silver.	
	Placers.		Deep mines.		Total value.	Fine ounces.	Value.
	Fine ounces.	Value.	Fine ounces.	Value.			
Cochise	24.00	$496	18,447.56	$381,345	$381,841	1,467,145	$1,467,145
Gila	25.30	523	1,808.74	37,390	37,913	233,650	233,650
Graham						169	169
Greenlee	29.70	614	1,068.70	22,092	22,706	47,959	47,959
Maricopa	44.84	927	465.57	9,624	10,551	376	376
Mohave			112,883.35	2,333,506	2,333,506	208,869	208,869
Pima	77.64	1,605	50.31	1,040	2,645	2,247	2,247
Pinal	19.98	413	1,120.90	23,171	23,584	108,078	108,078
Santa Cruz			24.67	510	510	16,058	16,058
Yavapai	283.24	5,855	5,182.36	107,129	112,984	383,193	383,193
Yuma	101.15	2,091	95.40	1,972	4,063	1,650	1,650
	605.85	12,524	141,147.56	2,917,779	2,930,303	2,469,394	2,469,394

County.	Copper.		Lead.		Total value.
	Pounds.	Value.	Pounds.	Value.	
Cochise	37,420,150	$4,827,199	5,497,032	$247,366	$6,923,551
Gila	76,612,995	9,883,076	173,346	7,801	10,162,440
Graham	199	26			195
Greenlee	11,422,397	1,473,489	6,246	281	1,544,435
Maricopa	7,177	926	11,097	499	12,352
Mohave	29,694	3,831	314,743	14,163	2,560,369
Pima	20,332,938	2,622,949	30,166	1,358	2,629,199
Pinal	12,388,772	1,598,152	96,191	4,329	1,734,143
Santa Cruz	72,190	9,312	201,763	9,079	34,959
Yavapai	26,576,298	3,428,342	172,150	7,747	3,932,266
Yuma	171,384	22,109	38,699	1,741	29,563
	185,034,194	23,869,411	6,541,433	294,364	29,563,472

ORE.

Of the various kinds of ore mined in Arizona in 1921 copper ore was mined in greatest quantity, followed by gold ore and dry or siliceous ores of silver. The total values of the ores not shown in the accompanying table are as follows: Dry gold ore, $2,437,478; dry gold and silver ore, $1,060; dry silver ore, $567,458; copper ore, $25,531,529; lead ore, $1,007,596; and copper-lead ore, $5,737. The placers produced gold and silver valued at $12,614, which makes the State total $29,563,472.

Ore and metal produced in Arizona in 1921.

Source of production.	Ore.		Gold.		Silver.	
	Short tons.	Per cent.	Fine ounces.	Per cent.	Fine ounces	Per cent.
Dry gold ore	182,194	3.34	114,044.05	80.46	79,538	3.22
Dry gold and silver ore	75	.....	23.67	.01	487	.02
Dry silver ore	50,932	.94	2,390.05	1.69	500,324	20.26
Copper ore	5,181,177	94.98	21,732.17	15.33	1,241,436	50.28
Lead ore	40,511	.74	2,947.62	2.08	645,563	26.14
Copper-lead ore	141	.....	10.00	.....	1,956	.08
Total deep mines	5,455,030	100.00	141,147.56	99.57	2,469,304	100.00
Total placers	.....	.....	605.85	.43	90	.....
Total, deep mines and placers, 1921	5,455,030	.....	141,753.41	100.00	2,469,394	100.00
Total, deep mines and placers, 1920	14,920,478	.....	231,528.65	.....	5,355,303	.....
Decrease, 1921	9,465,448	.....	89,775.24	.....	2,885,909	.....

Source of production.	Copper.		Lead.		Zinc.	
	Pounds.	Per cent.	Pounds.	Per cent.	Pounds.	Per cent.
Dry gold ore	301	.....	8,923	0.14	.....	.....
Dry gold and silver ore	312	.....	984	.01	.....	.....
Dry silver ore	121,290	0.06	46,264	.71	.....	.....
Copper ore	184,812,780	99.88	.....	.....	.....	.....
Lead ore	89,263	.05	6,435,217	98.38	.....	.....
Copper-lead ore	10,248	.01	50,045	.76	.....	.....
Total deep mines	185,034,194	100.00	6,541,433	100.00	.....	.....
Total deep mines, 1920	558,256,302	.....	14,599,765	.....	1,457,296	.....
Decrease, 1921	373,222,108	.....	8,058,332	.....	1,457,296	.....

GOLD ORE.

Gold ores, which represented about 3 per cent of the total output of ore, were mined by 26 producers in 1921, against 41 in 1920. These gold ores averaged $12.94 in gold and 0.44 ounce of silver, or $13.38 in all, to the ton. Yavapai County had the largest number of gold producers (14), but the largest quantity of gold ore was reported by 8 producers in Mohave County, followed by Cochise County with 2 producers.

Content of dry gold ores sold or treated in Arizona in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Cochise	1,630	971.97	699	.....	8,258
Gila	25	125.18	27	.....	.....
Greenlee	22	49.00	96	.....	.....
Maricopa	654	463.58	80	.....	503
Mohave	179,185	111,967.24	78,325	190	.....
Pima	20	17.00	2	.....	.....
Pinal	7	6.46	1	.....	.....
Yavapai	544	348.26	300	111	162
Yuma	107	95.36	8	.....	.....
	182,194	114,044.05	79,538	301	8,923

GOLD AND SILVER ORE.

Only two counties recorded a production of gold-silver ore, which averaged 0.31 ounce of gold and 6.49 ounces of silver, with a little lead and copper, and had a value of $14.13 a ton.

Content of dry gold and silver ores sold or treated in Arizona in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Pima	23	4.00	91	312	984
Santa Cruz	52	19.67	396	.....	.....
	75	23.67	487	312	984

SILVER ORE.

Of the silver ore, reported by 58 producers, the largest quantity came from mines in Cochise County, reported by 15 producers in the Turquoise and Tombstone districts. This ore averaged 97 cents in gold, 9.82 ounces of silver, and a little copper and lead and was valued at $11.14 a ton.

Content of dry silver ores sold or treated in Arizona in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds*
Cochise	46,550	2,095.83	360,219	101,013	1,870
Gila	1,658	17.38	61,464	13,542	24,912
Graham	8	.....	169	199	.....
Greenlee	1,155	173.68	23,104	1,900	5,639
Mohave	467	16.22	14,086	1,512	1,304
Pima	35	2.31	974	254	2,294
Pinal	895	78.63	27,676	611	7,267
Santa Cruz	24	.....	1,197	738	1,823
Yavapai	138	6.00	10,829	1,521	1,155
Yuma	2	.....	606	.....	.....
	50,932	2,390.05	500,324	121,290	46,264

COPPER ORE.

Of the copper ore mined in Arizona, 4,126,723 tons came from low-grade disseminated deposits worked by five producers near Globe, Ray, and Ajo, where most of the ore was treated. The richer siliceous ore, or that valuable as converter lining, was shipped to smelters. Similar disseminated copper ore amounting to 388,800 tons was mined and milled from the low-grade copper deposits in the Clifton and Morenci camps, Greenlee County. The crude copper ore mined and smelted directly (without previous concentration) amounted to 617,786 tons. The total output of copper ore mined and treated in 1921 averaged 0.24 ounce of silver a ton and 1.78 per cent of copper and was valued in all at $4.93 a ton.

Content of copper ores sold or treated in Arizona in 1921.

County.	Ore.	Gold.	Silver.	Copper.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*
Cochise	371,382	13,435.81	651,301	37,253,862
Gila	2,869,687	1,659.23	165,122	76,595,314
Greenlee	388,800	845.00	24,700	11,420,466
Maricopa	70	2.00	92	6,906
Mohave	95	1.00	103	11,498
Pima	929,323	.....	267	20,329,976
Pinal	429,874	1,028.00	77,434	12,387,131
Santa Cruz	292	.....	2,071	64,048
Yavapai	189,503	4,761.13	320,209	26,572,195
Yuma	2,151	.....	137	171,384
	5,181,177	21,732.17	1,241,436	184,812,780

LEAD AND COPPER-LEAD ORE.

Lead ore was mined in 10 counties by 52 producers, who reported an output averaging 0.07 ounce of gold, 15.94 ounces of silver, 7.94 per cent of lead, and a little copper, valued in all at $24.87 a ton. Most of the output of six producers of lead ore in Cochise County came from mines near Bisbee, in the Warren district, though the Tombstone district had a greater number of operators. In Mohave County six mines produced 12,120 tons of lead ore, the largest part of which was mined and shipped from the Wallapai district. Nine producers in Yavapai County reported 1,779 tons of lead ore, and five producers in Gila County reported 1,045 tons.

Copper-lead ore (141 tons) was reported from three mines in Gila, Pima, and Santa Cruz counties.

Content of lead ores sold or treated in Arizona in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Cochise	24,560	1,943.96	454,916	65,275	5,486,904
Gila	1,045	5.00	6,663	291	128,160
Greenlee	4	1.00	55	31	607
Maricopa	39	.....	201	271	10,594
Mohave	12,120	898.88	116,355	16,494	313,439
Pima	34	19.00	354	110	15,253
Pinal	167	7.78	2,963	1,030	88,924
Santa Cruz	610	5.00	11,347	3,290	181,804
Yavapai	1,779	67.00	51,819	2,471	170,833
Yuma	153	.....	890	.....	38,699
	40,511	2,947.62	645,563	89,263	6,435,217

GOLD.

Nearly 80 per cent of the total gold output was recovered from ore and tailings treated in gold and silver mills, and gold in crude ores shipped to smelters represented more than 16 per cent. From ores treated in mills by amalgamation gold valued at $17,822 was recovered, and that from ores treated by cyanidation amounted to $2,322,622. Concentrates contained $96,189, against $390,739 in 1920, and ores shipped directly to smelters contained $477,493, against $1,514,950 in 1920. The chief gold-producing districts were the San Francisco district, in Mohave County, where siliceous gold ores were produced; the Warren district, in Cochise County; and the Verde district, in Yavapai County, where copper ores were produced.

Of the mines producing gold the United Eastern was first, with 89,169.59 ounces, and the Tom Reed mine was second. Both these mines, which are at Oatman, produce siliceous ores. The Calumet & Arizona, at Bisbee, and the United Verde, at Jerome, producers of copper, made the next largest outputs of gold.

SILVER.

An increase in silver was recorded only in Mohave County. Bullion from gold and silver ores contained 134,564 ounces of silver recovered by cyanidation and 162 ounces recovered by amalgamation. Concentrates contained 13 per cent of the total output of silver and crude ore shipped to smelters nearly 80 per cent.

Of the total silver 65 per cent came from the ore of the Calumet & Arizona, Copper Queen, Bunker Hill, United Verde, and Commonwealth mines.

COPPER.

Most of the copper mines in Arizona became inactive in April, the Miami and New Cornelia companies being the only large ones that continued to produce copper throughout 1921. Crude ore shipped directly to the smelters yielded nearly 38 per cent of the total quantity. Of the output from crude ore smelted in 1921, Cochise County produced nearly 53 per cent. The low-grade disseminated ores in Pima, Pinal, and Gila counties yielded 99,056,957 pounds of copper, against 224,132,635 pounds in 1920. Similar low-grade copper deposits exist in Greenlee County, so that the total production from the disseminated deposits in Arizona was 110,477,423 pounds, or nearly 60 per cent of the aggregate output in 1921. In 1920 these ores altogether produced 259,227,635 pounds of copper.

Nine properties, each yielding more than 10,000,000 pounds, produced more than 94 per cent of the total quantity of copper. The Miami was first, followed by the New Cornelia, Copper Queen, Calumet & Arizona, Inspiration, United Verde, United Verde Extension, Arizona Copper, and Ray Consolidated mines.

LEAD.

The largest yield of lead was in lead ore produced at the Copper Queen mine, at Bisbee, which was followed by mines in Mohave and Santa Cruz counties.

MINING INDUSTRY.

When, early in 1921, the suspension of copper mining became general with no demand for the metal and with a price which, for many mines, was below the cost of production, it was plainly evident that production must cease. The copper camps remained closed from April until the end of 1921, except that the New Cornelia mine, at Ajo, produced to a small extent and the Miami Copper produced at the rate of about 4,500,000 pounds a month. Silver mining was active, particularly in the Tombstone district, whence the mine operators shipped their ore to the lead smelter at El Paso, Tex. Gold mining also showed continued recovery, especially in Mohave County. Lack of employment in the lode mines drove many miners, principally Mexicans, to work placers in various parts of Arizona.

Some relief was felt in September, when railroad rates were reduced for smelter products from points in Arizona and from Cananea, Mexico, to Baltimore and New England points by way of New Orleans or Galveston, in connection with the Southern Pacific Atlantic Steamship Lines. The rate to New England points was reduced from $21.10 to $17.60 a ton, and that to Baltimore was reduced from $20 to $16.50 a ton. These reductions were made to apply only on shipments forwarded by way of the Sunset-Gulf route.

May 1 the Copper Queen and Calumet & Arizona companies made a further reduction of 25 to 60 cents a day in wages for mine workers. All salaried employees of the companies were reduced to a figure that would be 5 per cent above base pay. At the beginning of 1921 the salaries paid were 37½ per cent above base pay. Miners are now getting $5.10 and muckers $4.60 a day. About 1,500 men were affected by the change.

REDUCTION MILLS.

Altogether there were 37 active milling plants in 1921. In 17 of these plants concentration devices were used, and 11 of them adopted the flotation process. Nine mills were equipped for the amalgamation process and nine for cyanidation. Acid leaching of the ores was done at Ajo, and experimental work was carried on at Inspiration. At Bisbee experiments continued with heap leaching. A list of milling plants operating and idle in 1920, giving the equipment of each plant, may be had upon request to the Bureau of Mines, Washington, D. C.

Gold and silver produced at mills in Arizona in 1921.

County.	Ore (short tons).	Bullion (fine ounces) recovered from ore by—				Total value.
		Amalgamation.		Cyanidation.		
		Gold.	Silver.	Gold.	Silver.	
Cochise	[a] 4,031	27.73	10	[b] 396.50	[b] 55,861	$64,641
Gila	26	125.18	27	.09	419	3,036
Maricopa	[c] 654	404.58	29			8,392
Mohave	179,068	52.47	28	[d] 111,769.67	[d] 77,778	2,389,375
Pima	21	17.00	2	1.00	61	435
Pinal	7	6.46	1			134
Santa Cruz	52			19.67	396	803
Yavapai	[e] 403	214.07	58	[f] 89.19	[f] 48	6,375
Yuma	107	14.66	7	80.70	1	1,979
	184,369	862.15	162	112,356.82	134,564	2,475,170

[a] Also yielded 7 tons of concentrate.
[b] Includes bullion from 10,000 tons of old tailings.
[c] Also yielded 11 tons of concentrate.
[d] Includes bullion from 150 tons of old tailings.
[e] Also yielded 1 ton of concentrate.
[f] Includes bullion from 110 tons of old tailings.

Concentration reduced 3,645,245 tons of ore to 200,957 tons of concentrates.

Mine production of metals from Arizona concentrates in 1921.

By counties.

County.	Ore to concentrating mills.	Concentrates produced.	Gold.	Silver.	Copper.	Lead.	Total value of concentrates.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Cochise	1,710	175	949.24	2,006	31	11,611	$22,155
Gila	2,830,449	126,590	1,338.00	107,665	72,797,225	95,662	9,530,471
Greenlee	371,924	31,383	627.00	18,700	9,780,618	.....	1,293,361
Maricopa	.....	11	59.00	51	.....	503	1,294
Mohave	12,020	1,244	886.88	110,381	15,532	258,819	142,365
Pinal	425,247	41,010	781.00	58,879	11,436,945	.....	1,550,390
Santa Cruz	296	74	.....	217	264	27,618	1,494
Yavapai	1,505	151	12.00	22,141	981	100,808	27,051
Yuma	2,094	319	.....	533	156,424	23,107	21,752
	3,645,245	200,957	4,653.12	320,573	94,188,020	518,128	12,590,333

By kinds of concentrates.

Dry or siliceous	.....	183	1,003.24	3,023	21	8,761	$24,159
Copper	.....	199,064	2,744.00	179,642	94,171,173	.....	12,384,447
Lead	.....	1,710	905.88	137,908	16,826	509,367	181,727

Average content.

Kind of concentrates.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	
Dry or siliceous	183	5.48	16.52	.....	2.39	$132.02
Copper	199,064	.01	.90	23.65	.....	62.21
Lead	1,710	.53	80.65	.49	14.90	106.27
	200,957	.02	1.60	23.43	.13	62.65

Of the material smelted, the copper ores constituted the largest part. The Warren or Bisbee district, in Cochise County, produced more than 60 per cent. The lead ores formed the next largest quantity, followed by dry or siliceous ores.

Mine production of metals from Arizona crude ore shipped to smelters in 1921.

By counties.

County.	Crude ore to smelter.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Cochise	413,998	16,897.35	1,366,369	37,083,970	5,485,421	$6,746,344
Gila	39,146	345.52	125,531	3,771,129	77,684	622,645
Graham	8	.....	169	199	.....	195
Greenlee	13,981	441.68	29,255	1,514,898	6,246	234,088
Maricopa	109	2.00	293	7,177	10,594	1,737
Mohave	629	174.32	20,682	14,162	55,924	28,630
Pima	1,235	32.31	2,168	170,145	30,166	26,142
Pinal	5,689	333.41	49,194	951,827	96,191	183,201
Santa Cruz	695	5.00	15,445	71,926	174,145	32,662
Yavapai	189,946	4,867.13	360,910	26,575,317	71,342	3,892,949
Yuma	212	.....	1,100	14,960	15,592	3,732
	665,648	23,098.72	1,971,116	70,175,710	6,023,305	11,772,325

By kinds of ore.

Dry or siliceous	22,224	2,046.80	399,767	121,882	47,248	$459,927
Copper	617,786	18,988.17	1,061,728	69,971,143	.....	10,480,526
Lead	25,497	2,053.75	507,665	72,437	5,926,012	826,135
Copper-lead ore	141	10.00	1,956	10,248	50,045	5,737

Mine production of metals from Arizona crude ore shipped to smelters in 1921.—Continued.

Kind of ore.	Crude ore to smelter.	Average content. Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	
Dry or siliceous	22,224	0.09	17.99	0.27	0.11	$20.70
Copper:						
Oxidized	111,735	.01	1.92	6.61		19.20
Sulphide	506,051	.03	1.67	5.45		16.47
Lead:						
Oxidized	24,938	.07	18.70	.14	11.40	30.94
Sulphide	559	.18	74.11	.37	21.30	97.68
Copper-lead:						
Oxidized	56	.03	6.54	3.44	18.10	32.41
Sulphide	85	.09	18.71	3.76	17.51	46.14
	665,648	.03	2.96	5.27	.45	17.69

REVIEW BY COUNTIES.

COCHISE COUNTY.

Mine production in Cochise County, Ariz., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	44	1,541,480	$919,167	2,314,977	121,506,500	9,549,906	$26,563,680
1921	31	444,122	[a] 381,841	[a] 1,467,145	37,420,150	5,497,032	6,923,551
Decrease, 1921	13	1,097,358	537,326	847,832	84,086,350	4,052,874	19,640,129

[a] Includes placer production.

In Cochise County all metals decreased in quantity. The value of the output of silver decreased from $2,523,325 to $1,467,145, gold from $919,167 to $381,841, copper from $22,357,196 to $4,827,199, and lead from $763,992 to $247,366. No zinc was reported in 1921. Ore of smelting grade (413,998 tons) predominated and averaged $16.30 a ton. The total content of each metal is given in the table on page 318. Of the ore smelted 371,382 tons was classified as copper ore, of which 102,182 tons was estimated to be oxidized ore and 269,200 tons sulphide ore. All the lead ore smelted, 24,450 tons, was shipped to plants outside the State, and contained 1,938.97 ounces of gold, 453,979 ounces of silver, 65,244 pounds of copper, and 5,483,551 pounds of lead. All but 17 tons of this ore was oxidized. Milling ore produced 153 tons of siliceous concentrate and 22 tons of lead concentrate, which were also shipped. A small placer output was reported by two operators.

Cochise district (Johnson and Dragoon).—A small lot of silver-lead ore was shipped from the Texas-Arizona property.

Dos Cabezas district.—Concentrates from ore of the Gold Prince mine were shipped to the El Paso smelter. The product contained 6 ounces of gold and 4 ounces of silver to the ton. The concentra-

tion mill, which is equipped with Deister-Overstrom tables, was operated only a short time. Lead ore containing gold and silver was shipped from the property of the Le Roy Consolidated Mines Co. Mine development was discontinued awaiting a higher price for lead. In December 250 men were reported on the pay roll of the Central Copper Co., which is developing 30 mining claims of its own and 56 held under a 20-year lease from the Mascot Copper Co. The property is opened to a depth of 900 feet by tunnels and shafts aggregating 33,000 feet. The 50-ton mill equipped for wet and magnetic concentration was not operated. This company is also developing the Elma-Roseberry group of claims in the Tevis-ton mining district. The Mascot & Western Railroad, a broad-gage line, connects Willcox, on the Southern Pacific Railroad, with the Dos Cabezas district.

Hartford district (*Herford and Garces*).—Placer gold and mill bullion sold to bullion dealers was reported as coming from the Hartford district.

Swisshelm district (*Webb*).—Four cars of lead ore, partly sulphide, were shipped from the Four Horse claim, formerly the Mountain Queen. This ore was reported to have been taken out during development work. The mine is 15 miles from Webb, a station on the El Paso & Southwestern Railway.

Tombstone district.—The output of 15 producers in the Tombstone district was 8,594 tons of ore and 10,000 tons of old tailings, which contained $31,141 in gold, 423,688 ounces of silver, 132,688 pounds of copper, and 678,946 pounds of lead, valued in all at $502,498, or $17.57 a ton. Silver bullion was recovered by cyanidation from the tailings dump of the State of Maine property. The largest output was reported from the Bunker Hill property, which produced considerable silver ore and oxidized lead ore. Shipments were also made from the Free Coinage, Junetta & Sunset group, Bonanza, Rocky Bar, and Side Wheel claims. Tests of old dump material were made in the mill of the National Metals Recovery Co., which rebuilt the Old Guard mill and shipped silver-lead concentrate. At the Bunker Hill property [2] operations in 1921 were confined solely to the work of lessees. The closing of the smelters at Douglas stopped all production by the company, which continued development work.

Turquoise district (*Courtland, Pearce, and Gleeson*).—Five properties in the Turquoise district produced 12,327 tons of ore and 14,383 tons of old tailings. All the old tailings was shipped to smelters, but part of the ore was treated by cyanidation. The total output was $31,169 in gold, 172,381 ounces of silver, 36,767 pounds of copper, and 490 pounds of lead. Silver bullion was recovered from Commonwealth ore treated in the 50-ton cyanidation plant, and silver ore was shipped from the Commonwealth Extension claim. The Leonard and Germania mines were operated a short time. In the Leonard property, which produced sulphide ore, the ore reserve is reported to be between 300,000 and 500,000 tons of 2 per cent copper ore carrying $2 a ton in gold and silver, 32 per cent of iron, and 35 per cent of sulphur.

Warren district (*Bisbee, Lowell, and Warren.*)—The smelting of copper ore from all the producing properties in the Warren district

[2] Phelps Dodge Corporation Ann. Rept. for year ending Dec. 31, 1921.

ceased in April. During the remainder of 1921 ore was stored and development work at the mines was cut to the minimum. The output of the district was 386,929 tons of ore, mostly of shipping grade, which contained 14,387.81 ounces of gold, 865,029 ounces of silver, 36,913,323 pounds of copper, and 4,670,597 pounds of lead. Some copper was obtained from precipitates. The lead was contained in ore shipped to the smelter at El Paso, Tex. The output of the district was only a small part of the ore mined, which amounted to 940,370 tons from the three large producers. Considerable copper ore, steam-shoveled from Sacramento Hill and piled at Bisbee, was of smelting and milling grade, and some of it was put on the dump for heap leaching. Joseph Irving, jr., recently read a paper before the Bisbee chapter of the American Association of Engineers, in which he described the method that will be used at the Copper Queen mines in leaching the ore mined by steam shovel. The following extracts are quoted [3] from his paper:

> In order to prove out sundry smaller experiments a 10,000-ton heap was built at the foot of Sacramento Hill and leached continuously for three years and three months. An average of all the samples showed that an extraction of 73 per cent had been made in this time, which compared favorably with the estimated 80 per cent extraction in five years.
>
> One side of the heap, where proper oxidation had taken place, showed extraction of 90 per cent in three years. In laying out this heap no attempt was made to crush the ore, the larger pieces, which naturally rolled to the bottom as the heap was being built, were used to build culverts and drains, and this brought them closer to the oxidizing influence of the atmosphere. This caused them to yield their copper about as fast as the smaller pieces near the top.
>
> The method used was the simple ferric-sulphate process—that is, the solution from the precipitating plant was pumped to the top of the heap and allowed to percolate downward through the heap, being enriched in copper during its course and being drained from the bottom into the precipitating plant, where its copper content was recovered by precipitating on scrap iron. The cycle was then repeated.
>
> This was the first successful attempt at heap-leaching in the United States. A number of important innovations have been developed that will greatly shorten the period of treatment of low-grade ores by this method. It has been pointed out that the main defect of this method is the long period of treatment required, which is quite true, but when it is considered that leaching operations can be started as soon as a few tons of ore has been mined and laid out, and that there is no initial expense for crushing and leaching-plant, and that the extraction in the first year is nearly always about half of what it will be in five years, the advantages soon outweigh the one main disadvantage.
> * * *
>
> Two men will operate the plant, where a plant of the ordinary kind would require at least ten or twelve men. All the dirty and unpleasant work will be eliminated.

Construction work was continued on the 4,000-ton concentrator and the power plant of the Copper Queen mine at Bisbee. These plants were expected to be complete in April, 1922. According to its annual report [4] the Copper Queen mine produced 515,632 tons of ore.

[3] Min. and Sci. Press, vol. 122, p. 25, Feb. 12, 1921.
[4] Phelps Dodge Corporation Ann. Rept. for year ending Dec. 31, 1921.

Ore and metals contained in output of Copper Queen mines, Arizona, 1921.

Kind of material.	Short tons.	Gold.	Silver.	Copper.	Lead.
		Ounces	*Ounces.*	*Pounds.*	*Pounds.*
Underground—copper	143,241	2,326	197,286	18,696,487	.....
Underground—lead	15,807	960	214,201	40,472	4,916,418
Total underground	159,048	3,286	411,487	18,736,959	4,916,418
Steam shovel—high grade	16,654	164	9,923	1,854,137	.....
Steam shovel—low grade	339,496	1,200	73,704	9,682,928	.....
Total steam shovel	356,150	1,364	83,627	11,537,065	.....
Precipitates	434	.....	65	336,149	.....
Total, 1921	515,632	4,650	495,179	30,610,173	4,916,418
Total, 1920	.....	8,846	486,698	71,443,396	243,836
Total, 1919	.....	10,813	492,326	68,614,002	9,372
Total, 1918	.....	16,409	558,433	90,988,156	1,234,497
Total, 1917	.....	19,156	828,665	93,618,409	6,870,128
Total, 1916	.....	24,030	1,096,136	102,685,722	9,421,562

Of the total ore mined 145,441 tons went to the leaching dump at Bisbee, 486,653 tons were concentrating ore. and 171,618 tons were direct smelting ore. Shipments of lead ore from the Copper Queen branch amounted to 15,807 tons. * * *

Limestone mine copper production was suspended on April 12. The underground output from January 1 to that date was 122,136 tons of ore and 16,352,590 pounds of copper. The output from April 12 to the end of the year, amounting to 19,800 tons of ore and 2,258,585 pounds of copper, came entirely from prospect and development work. Sacramento Hill ore production showed a notable increase in 1921. Steam shovel operations were discontinued at the end of October on completion of the stripping work necessary for ore production. During the period of operation 702,009 solid yards of waste were removed, and 29,346 tons of ore averaging 4.67 per cent copper and 326,804 tons of ore averaging 1.34 per cent copper were produced. The cost per yard, due to more efficient organization and better working conditions, showed a marked improvement.

After the discontinuation of ore production in the limestone mines, a considerable number of men were employed on prospect and development work. The total footage driven, including winzes, shafts, and stations, amounted to 57,093 feet, as compared with 48,271 feet in 1920. Ore reserves, not including the Southeast extension of Sacramento Hill East Ore Body, showed an increase. In the Sacramento Division considerable tonnage was added to the 14–10 Ore Body, and in the White Tail Deer district, the Night Hawk and Boras Leasing companies added to their reserves.

The mineralogic and geologic features of the copper replacement deposits in the Warren district were interestingly reviewed in a recent article.[5]

The Calumet & Arizona mines [6] produced 218,393 dry tons of ore, which was sampled at various smelters. Of this output, 181,735 wet tons was shipped to the company smelter at Douglas and 19,495 tons of "exchange" ore of the same grade was shipped to the Copper Queen smelter at Douglas. The New Cornelia Copper Co., at Ajo, received for roasting 12,689 tons of low-grade copper ore high in sulphur, and the Old Dominion Co., at Globe, received 3,150 tons for smelting. From this output of ore 17,855,613 pounds of copper, 419,647 ounces of silver, and 12,364.89 ounces of gold were recovered. Dividends paid in 1921 amounted to $1,285,043, which, added to the total since 1903, makes $46,915,513, or $115 a share. The dividends in 1921 were paid out of surplus accumulated since March 1, 1913. The company's annual report contains the following notes:

[5] Mitchell, J. G., Replacement copper deposits in the Warren district: Eng. and Min. Jour., vol. 112, pp. 246–250, Aug. 13, 1921.

[6] Calumet & Arizona Mining Co. Ann. Rept. for year ending Dec. 31, 1921.

In common with nearly all copper mines, the Calumet & Arizona properties have passed through a year of heavy curtailment. Until the middle of April, the Briggs and Junction mines produced ore enough to keep two reverberatory furnaces running at the smelter, which made about three million pounds of copper per month during that period. On April 18 smelting was discontinued. For the rest of the year a small force of men was kept at the smelter to sample, crush, and bed the ore which was received from the mines, to run the boilers and turbine which furnish power to the mines, and to carry on necessary repairs. At about the same date the force at the mine was cut to 550 men, who were to do 2,500 feet of development work and to mine 15,000 tons of ore per month. * * *

In spite of the drastic curtailment, part of the deficiency in development of the preceding two years was made up. About 5.2 tons of ore were mined per foot of development in 1921, compared with 9.4 tons in 1920. Over 50 per cent of the workings planned by the Geological Department found ore. This is a very good record in the Warren district. No large new ore bodies were developed, but several discoveries of ore in new areas may develop into important producers. * * * All stopes are filled and ready to resume production on a day's notice. The Junction shaft is down 2,358 feet, and concreting of the lower part of the shaft and of stations is proceeding without incident in spite of extremely heavy and dangerous ground. It will not be necessary to sink this shaft again for many years, as indicated by the fact that the average depth from which Junction ore has been stoped has increased at the rate of only 11 feet per year for the past 10 years. The lower levels can now be opened slowly enough to prevent large flows of water, and progressive levels can be drained by deeper workings before it is necessary to start extensive operations on them. This will greatly reduce the cost of opening new levels. * * *

From the Shattuck-Arizona property [7] 1,814 dry tons of ore was mined up to the first of August in the course of development work. This ore was shipped to the smelters, where 287,928 pounds of copper, 28.81 ounces of gold, and 12,093 ounces of silver were recovered. A large deposit of rich copper ore was said to have been opened on the 600-foot level.

GILA COUNTY.

Mine production in Gila County, Ariz., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	36	7,415,052	$146,463	594,979	179,574,627	1,650,427	$33,968,755
1921	33	2,872,471	[a] 37,913	[a] 233,650	76,612,995	173,346	10,162,440
Decrease, 1921	3	4,542,581	108,550	361,329	102,961,632	1,477,081	23,806,315

[a] Includes placer production.

Most of the ore produced in Gila County was treated locally, but lead ores and part of the copper ores were shipped to plants outside of the county. Of the copper ore smelted, 29,017 tons was sulphide and 8,321 tons oxidized. The 39,146 tons of smelting ores shipped had an average value per ton of $15.91, and 126,590 tons of concentrates, chiefly copper, an average value per ton of $75.29.

Banner district.—Five mines in the Banner district produced 2,364 tons of ore, containing $660 in gold, 1,595 ounces of silver, 124,491 pounds of copper, and 20,274 pounds of lead, valued in all at $19,226. Most of the output was from the Christmas mine, operated by the Gila Copper Sulphide Co., which shipped its ore to the smelter at Hayden. The Seventy-nine mine produced oxidized lead ore, and

[7] Shattuck-Arizona Copper Co. Ann. Rept. for year ending Dec. 31, 1921.

gold and silver bullion was recovered from panning some ore from the Apex mine. The average assay of ore from the Seventy-nine mine was 0.0366 ounce of gold and 5.5 ounces of silver to the ton, 33.06 per cent of lead, and 0.83 per cent of copper. The ore is loaded at Burns siding, a station on the Arizona & Eastern Railway, 4½ miles from the mine.

Dripping Springs district.—Gold was recovered from about 600 pounds of ore amalgamated in a mill of the Dripping Springs Development Gold Milling Co. This property has a 200-foot adit and a 90-foot shaft, and is situated 20 miles from Winkelman.

Globe (Miami) district.—Twenty producers in the Globe district reported the output of 2,870,072 tons of ore. The Miami Copper Co. operated its mine and mill continuously and was the largest producer in the district, followed by the Inspiration and Old Dominion mines, whose plants were closed from April 1 to the end of the year. The output of the district was $34,410 in gold, 229,303 ounces of silver, 76,488,211 pounds of copper, and 152,770 pounds of lead, valued in all at $10,137,567, or $3.54 a ton. Most of this ore was reduced to 126,590 tons of concentrates, nearly all of which was copper concentrates. Producers of silver ore were the Dundee group, Globe Dominion, Husband and Wills, Mineral Creek group, near Bellevue, Rambo, 5 miles north of Globe, and El Capitan. The Irene property produced lead ore, which was shipped to El Paso, Tex.

The milling plant of the Miami Copper Co.[8] operated at about 80 per cent of normal capacity during 1921, and milled an average of 5,176 tons of ore a day for 361 days. Ore mined for the year amounted to 1,869,307 tons, of which 98,730 tons was obtained from development and 1,770,577 tons from stoping the main ore body by the undercut-caving method of mining. Dividends amounting to $1,494,228 were paid to stockholders in 1921. The company's annual report gives the following paragraphs:

> Following the policy of curtailment inaugurated in 1919, an average of less than five mill sections was operated. The results of these operations were as follows:
>
> Ore milled, 1,868,757 tons, at 1.758 per cent copper.
> Concentrate produced, 73,123 tons, at 38.372 per cent copper.
> Copper in concentrate, 56,117,827 pounds.
> Copper per ton ore, 30.03 pounds.
> Mill extraction, 85.37 per cent.
>
> The cost of milling ore to the point of concentrate on board cars is as follows:
>
Direct crushing expense	$0.35983
Direct concentrating expense	.19784
Tailing and concentrate handling	.06095
Water for concentrating	.05825
Miscellaneous expense	.02777
	.70464

> The total milling cost dropped 12 cents per ton as compared with the previous year; this in spite of higher power cost, the reduction being due principally to lower labor costs and a reduction in the amount of our experimental work.
>
> The metallurgical results in the mill were very good, the copper extraction being 85.367 per cent and the sulphide copper in the mill general tailing being 0.132 per cent. These are the best yearly figures which have been obtained since the beginning of operations in 1911.

At the Old Dominion mine[9] 61,753 dry tons of ore averaging 5.31 per cent of copper was produced. This output consisted of 19,967

[8] Miami Copper Co. Ann. Rept. for year ending Dec. 31, 1921.
[9] Old Dominion Co. Ann. Rept. for year ending Dec. 31, 1921.

tons of smelting ore averaging 6.8 per cent of copper, 40,672 tons of concentrating ore averaging 4.56 per cent, and 1,114 tons of siliceous ore, used for converter lining, averaging 3.39 per cent. The total production for 1921, including the metal from custom ore, was 7,389,648 pounds of refined copper, 71,155 ounces of silver, and 1,186.88 ounces of gold. Altogether the company sold 14,902,677 pounds of refined copper at an average price of 12.81 cents a pound. The smelter of the company was closed April 12, and a small force of men at the mine kept up repairs and continued the operation of the pumps. After the mine stopes were closed a little development work was done, which was confined to the eighteenth and twentieth levels. No dividends have been paid since December, 1918.

Mining ceased at the Inspiration property [10] March 31. During the three months of operation on a 50 per cent basis the undercutting area produced 898,823 tons of ore which averaged 1.13 per cent of copper. This ore was mined at the rate of 19.1 tons per man shift for all labor chargeable to the mining division, as compared with 19.69 tons for 1920. The Live Oak division produced 653.7 tons of oxidized ore, containing 10.24 per cent of copper, which was used in the experimental work on the leaching of oxidized ores, and 1,152.7 tons was directly smelted. Work was begun in the old Montezuma workings of the Warrior group, and in the course of development 1,932 tons of ore averaging 3.72 per cent of copper was shipped to the smelter. From the milling of 912,934 tons of ore, including some ore leached, 15,174,768 pounds of copper was produced. The cost of fine copper during the short period of operation, including depreciation but excluding depletion, Federal taxes, and shut-down expenses, amounted to 15.2 cents a pound. A large area of ground, 561 acres, was added to the Inspiration property in 1921 by the purchase of the property of the Porphyry Copper Co. and the Porphyry Consolidated Copper Co. This acquisition permits the economical development and extraction of the Keystone and Live Oak ore bodies, which it adjoins.

The Superior & Boston mine [11] produced 11,107 dry tons of ore, assaying 4.37 per cent of copper and 5.88 ounces of silver to the ton, between September, 1920, and April, 1921. This ore output contained a total of 970,653 pounds of copper and 65,352 ounces of silver for which the company received $95,022.74 after smelting and freight charges were deducted. When the copper smelters were closed attention was given to the development of silver ore. About 36 tons of ore was shipped to El Paso, assaying 194.9 ounces of silver to the ton. Further development work done on the silver vein was reported to be encouraging.

From the Iron Cap mine [12] 4,424 tons of ore was milled, averaging 4.92 per cent of copper and 1.07 ounces of silver a ton. From this ore 776 dry tons of concentrate was recovered, averaging 29.44 per cent of copper and 6.21 ounces of silver a ton. The total content of the concentrate was 405,962 pounds of copper and 4,447 ounces of silver. The average price received for the copper was 12.5 cents a pound and for the silver $1.01 an ounce. The mine and mill were closed February 15.

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[10] Inspiration Consolidated Copper Co. Ann. Rept. for year ending Dec. 31, 1921.
[11] Superior & Boston Copper Co. Ann. Rept. for year ending Sept. 30, 1921.
[12] Iron Cap Copper Co. Ninth Ann. Rept., for year ending Dec. 31, 1921.

The Arizona Commercial mine[13] did not produce ore from either its Copper Hill or its Eureka mine in 1921. The output of 572,616 pounds of copper, 3,001 ounces of silver, and 162.51 ounces of gold was from ores on hand at the beginning of 1921.

Green Valley (Payson) district.—The Minnesota mine produced gold ore treated in a 2-stamp amalgamation mill, which is equipped with a concentrating table. The mine is opened by a vertical shaft 100 feet deep and an incline shaft 150 feet. Gold bullion was also credited to the Columbia property and the Callaghan group.

Gun Creek district.—A small lot of gold quartz from property on Spring Creek was treated in an arrastre.

Mazatzal district.—A small lot of silver ore containing a little copper and lead, resulting from surface work on the Dos Oro claim, was shipped to the smelter at El Paso, Tex.

Richmond Basin district.—From the Gila Monster and Jumbo groups, 14 miles north of Globe, several small lots of high-grade silver ore were shipped to the Old Dominion smelter. These claims cover the McMorris property, known in the eighties as one of the famous silver producers. A 30-ton mill equipped for cyanidation was erected but not operated.

GRAHAM COUNTY.

Bunker Hill (Copper Creek) district.—The Kilbourg property produced a small lot of silver ore containing a little copper. The property is 40 miles from the railroad.

GREENLEE COUNTY.

Mine production in Greenlee County, Ariz., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	10	1,035,870	$79,841	147,428	35,748,276	.....	$6,818,221
1921	10	389,981	[a] 22,706	[a] 47,959	11,422,397	6,246	1,544,435
Increase or decrease, 1921	.....	−645,889	−57,135	−99,469	−24,325,879	+6,246	−5,273,786

[a] Includes placer production.

Ashpeak district (Duncan).—Several lots of ore were shipped from the Ashpeak Extension property, which is 10 miles from the railroad station at Duncan. One carload of 33 tons carried 30.8 ounces of silver, 9.3 per cent of lead, and 3.93 per cent of copper.

Copper Mountain and Greenlee districts (Morenci, Metcalf, and Clifton).—With the exception of the output of the Ashpeak district, the figures given in the Greenlee County table represent the production from the Copper Mountain and Greenlee districts. Only 795 tons of ore, mined by four producers, was reported from the Copper Mountain district, and 388,800 tons from the Greenlee district, mined by

[13] Arizona Commercial Mining Co. Ann. Rept. for year ending Dec. 31, 1921.

the Arizona Copper Co. The total output of the two districts was $21,554 in gold, 40,655 ounces of silver, and 11,420,497 pounds of copper, valued in all at $1,535,480. The properties of the Phelps Dodge Corporation were operated and 7,242 feet of development work was reported, besides 1,452 feet of churn-drill holes put down while prospecting the Detroit property. Small lots of ore were shipped from the New York-Arizona, Stargo, and Cupelli-Brancati group.

At the end of 1921 the Arizona Copper Co. (Ltd.) was purchased by the Phelps Dodge Corporation. The consolidation of this property with the Detroit and other mines of the Morenci branch of the corporation adds a considerable quantity of low-grade ore, which gives an opportunity for production on a large scale. The report[14] of the corporation gives further details as follows:

> The mining claims of the Arizona Copper Co. (Ltd.), originally acquired 40 years ago, adjoined and interlocked with the claims of the Morenci branch, the ore bodies in most cases extending from the property of one company into the holdings of the other. A vertical side-line agreement entered into many years ago removed the danger of apex litigation, but the physical difficulties, embarrassment, and expense in the separate exploitation of these ore bodies and the beneficiation of the ores brought about a condition which it was obviously to the interest of both companies to remove if possible. * * * The Phelps Dodge Corporation, in consideration of the turning over to the Arizona Copper Co. (Ltd.) of the 50,000 unissued shares of its capital stock acquired all the assets and liabilities of that company, including the Arizona & New Mexico Railroad, which connects Clifton with the Southern Pacific at Lordsburg and the El Paso & Southwestern system at Hachita. * * * We have also acquired amongst the assets a 4,000-ton per day concentrator, which is susceptible of an increase to 5,000 tons, and a modern smeltery with a capacity of 5,000,000 pounds of copper per month. * * *
>
> Underground development work was continued (at the Morenci branch) until April, at which time the mine was closed down and remained so during the balance of the year. The total footage driven for the year was 7,242 feet. In addition, 1,452 feet of churn-drill holes were driven to explore the area below the seventh level, Ryerson mine, the result of which demonstrated that the 41 ore body continues downward to the ninth level.
>
> A total of 2,737 tons of ore was extracted by development work during the first three months of the year and placed in stock.

The Arizona Copper Co. (Ltd.) issued its annual printed report for operations ending September 30, 1920, in October, 1921. For the fiscal year ending in 1920 the mine produced 35,700,000 pounds of Bessemer copper, which compares with 36,460,000 pounds for the previous fiscal year. The total ore mined amounted to 1,046,331 tons and contained 32.83 pounds of copper to the ton of ore. Of this ore the total treated by concentrators was 1,002,094 dry tons, of which No. 6 concentrator treated 955,830 tons and the experimental mill 46,264 tons. The average grade of ore was 2.08 per cent of copper, of which 0.36 per cent was in oxidized form, and a total extraction of 75.53 per cent was obtained. Of smelting ore 147,206 dry tons was treated, including considerable slag and refuse from around the smelter. The dismantling of the Shannon smelter and concentrator was continued. During 1920 the Stevens group of 39 patented mining claims was purchased, and in 1921 all the property of the Arizona Copper Co. was sold to the Phelps Dodge Corporation. However, the production of copper was continued to May 31 and an output of 11,420,466 pounds of copper was reported from ore, concentrate, and slag.

[14] Phelps Dodge Corporation Ann. Rept. for year ending Dec. 31, 1921.

MARICOPA COUNTY.

Most of the ore from Maricopa County (654 tons) was treated in gold and silver mills and produced bullion valued at $8,392 and 11 tons of concentrate. The remainder (109 tons) was shipped directly to smelters and had an average value of $15.94 a ton. A little placer bullion was reported in 1921 by two operators.

Bitter Creek district.—On the Virl property a small testing plant using a patented amalgamation process was operated and a little gold bullion recovered. This property is near the Morristown post office.

Painted Rock (Rowley) district.—Development work was carried on at the Rowley mine, and several small lots of ore were shipped which did not pay freight and treatment charges. The property is opened by a vertical shaft 260 feet deep and has a 4-compartment inclined shaft 240 feet deep. Another inclined shaft is 195 feet deep. The ore mined contains gold, silver, copper, lead, molybdenum, and barite. There is an estimated ore reserve for future operations of 10,000 tons of wulfenite ore, from which it is said 1 per cent of molybdenum can be recovered, in addition to an estimated content of 800,000 pounds of lead. The ore is hauled to Tartron siding on the Southern Pacific Railroad, 11 miles from the mine.

Vulture district.—A 10-stamp amalgamation mill was reported in process of construction on the El Tigre property, and gold bullion was produced from the ore treated in 1921. An arrastre was operated on gold ore taken out in developing the old Garcia property, 9 miles southeast of Wickenburg. All activity in the Vulture mine ceased in 1917. The mine was allowed to fill with water, and in 1919 the equipment was advertised for sale. A very interesting account of the early history of the mine, its production and geology, with illustrations of the faulting, is given in a recent article.[15]

MOHAVE COUNTY.

Mine production in Mohave County, Ariz., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	34	203,158	$2,852,141	147,612	121,125	513,902	$3,076,437
1921	20	191,867	2,333,506	208,869	29,694	314,743	2,560,369
Increase or decrease, 1921.	−14	−11,291	−518,635	+61,257	−91,431	−199,159	−516,068

Most of the ore produced in Mohave County is of milling grade and yields bullion or concentrates. The ore treated by amalgamation or cyanidation amounted to 179,068 tons, which produced $2,311,569 in gold and 77,806 ounces of silver, having a total value of $2,389,375, or an average of $13.34 a ton. The concentrating ores (12,020 tons) produced 1,244 tons of concentrates, against 1,554 tons of ore and 219 tons of concentrates in 1920. The concentrates in 1921 had a total value of $142,365, or an average of $114.44 a ton. Crude ore shipped to smelters amounted to 629 tons, against 2,748 tons in 1920.

[15] Hutchinson, W. S., The Vulture mine: Eng. and Min. Jour., vol. 111, pp. 298–302, 1921.

In 1921 shipping ore had a total value of $28,630, or an average of $45.52 a ton.

Cedar Valley district.—Copper ore mined from the Antler group was shipped to Hayden, and a small production of lead concentrate from one of the mills in the Cedar Valley district treating Diamond Joe ore was shipped to the Selby smelter.

Greenwood district.—The Bland mine produced a small quantity of gold bullion recovered in an arrastre, and old tailing from the Peabody property was treated by cyanidation and yielded silver.

Indian Secret district.—The White Hills mine, a producer of silver in the nineties, was opened during 1921. Cyanidation tests were made on the old tailing left from the operation of a 40-stamp mill, which has been overhauled. A small lot of material containing silver was sold. The mine is 80 miles north of Kingman.

Maynard district.—Operations at the Dean mines were continued during 1921. The new mill, using a flotation process, produced a rich concentrate, which, with some crude ore, was shipped to several smelters. The ore carries silver with a little lead and copper.

Owens district.—From the Silver Triangle claim a small lot of sulphide and carbonate ore, containing silver and copper, was hauled 11 miles to Clara siding, near Swansea, on the branch railroad to Bouse.

San Francisco district (Oatman, Gold Road, and Vivian).—The Tom Reed and United Eastern mines continued to be the largest producers in the San Francisco district. Ore from these mines and several small tests of ore from other properties brought the production of the district up to 179,013 tons in 1921, compared with 197,629 tons in 1920. The total value of the bullion recovered from the ore produced in 1921 was $2,388,050 in gold and silver, or $13.34 a ton. All the bullion was recovered by cyanidation.

From the United Eastern mine [16] 97,413 tons of ore was produced, against 102,926 tons in 1920. The greater part of the ore in 1921, or 95,807 tons, was mined from the sixth, seventh, and eighth levels of the Tom Reed Extension claims, and the remainder, 1,606 tons, from the Big Jim claim on the third, fourth, and fifth levels. The metal recovery from Tom Reed Extension ore was 88,214.91 ounces of gold and 66,171 ounces of silver, and from Big Jim ore 954.68 ounces of gold and 679 ounces of silver. These figures include the content of tailing-pond skimmings. In 1921 the gold recovered by cyanidation was valued at $1,843,296.99 and the silver at $66,756.79, or a total value of $1,910,053.78. The average value of the ore treated was $20.23 and the tailing loss was 62 cents, representing a recovery of 96.93 per cent, or $19.61 a ton. Mining costs averaged $4.39 a ton and direct milling costs $1.95 a ton, which, with costs of shaft sinking (No. 2 shaft), marketing, and indirect costs, brought the total cost to $9.50. The net income from operations in 1921 was $9.93 a ton, or $966,195. Dividends paid since 1917 amounted to $3,952,700, of which $817,800, or 60 cents a share of stock, was paid in 1921. An aerial tramway was erected and put in operation December 6, 1921, to carry ore from the Big Jim mine to the mill at the rate of 50 tons an hour. Ore reserves in the Tom Reed Extension claim were not added to during 1921, so the original ore body is

[16] United Eastern Mining Co. Ann. Rept. for year ending Dec. 31, 1921.

rapidly approaching exhaustion. The work of preparing the Big Jim mine for development was started March 29, 1921. The company reviews the conditions of the mine in the following paragraphs:

The Big Jim shaft was enlarged from two to three compartments from the fourth level to the surface and was retimbered from below the fifth level to the surface.

The third level station and ore pocket was cut and a crosscut vein was driven to tap the vein at the Big Jim raise. The fourth, fifth, and sixth level stations and crosscuts were enlarged and a pocket was cut at the fifth level. A raise was driven from the fifth level pocket to the fourth level and serves as a pocket for ore from the fourth level.

The shaft was sunk an additional 134.7 feet and the seventh level established 722 feet below the collar. The seventh level crosscut shows the vein to be very narrow and practically barren of values near the shaft.

The vein on the third level is being developed and stopes are being prepared for ore extraction on the third and fourth levels.

The United Eastern vein apparently continues to the northwest from the Tom Reed Extension claim; passes through the Red Cloud claim of the Tom Reed Gold Mines Co., and into the Red Cloud Extension claim, which belongs to the United Eastern. For the purpose of prospecting this area of United Eastern holdings, a two compartment shaft (No. 3) was sunk under contract.

Work was started June 20, 1921, and the shaft was completed at a depth of 870 feet on November 4, 1921. The average price paid the contractor was $22.28 a foot. The total cost per foot was $49.08, which covers shaft timbers, headframe, building, setting of machinery, grading, and all other charges except indirect costs.

A station was cut at the 850-foot level and diamond drilling was resorted to as the quickest method for locating and determining the character and value of ore, if any, in the vein. The small amount of drilling done to date indicates that the vein is split up into many small stringers of no value.

The Tom Reed mine,[17] during its fiscal year, produced 69,832 tons of milling ore, which was treated by cyanidation. Gold and silver recovered had a combined value of $377,991.83, or an average of $5.65 a ton, with an average tailing loss of 24 cents a ton. The cost of mining and milling, including development, taxes, depreciation, and administrative expenses, amounted to $7.70 a ton, compared with $6.72 in 1920. Reviewing the development in the mine the company report says:

On the 700-foot level of the Aztec exploration was carried to the west end-line of the Aztec Center claim; on this level two ore bodies were exposed, one near the Aztec shaft, the other near the west-end line of the Aztec Center claim. Both the tonnage and assay values obtained in this development work have been as a whole disappointing. While a considerable tonnage has been mined from this level, the grade of the ore has allowed us but very little profit. Development of the upper segment of the vein, directly south of the Aztec shaft, won for us a small body of ore, known as the 3,700; we found this ore lying very flat and badly broken, due to the complicated faulting of the vein in this locality. Increased mining costs, due to these conditions, allowed us to win but a meager profit from this body of ore.

At the Red Cloud our chief objective and accomplishment has been the extension of the drift to both the east and west on the 725-foot level. Drifting and crosscutting at stated intervals has progressed along the vein at the said horizon; while the vein has improved very materially both in appearance and values, we have not as yet uncovered an ore body of commercial value. Diamond drilling, from the 725-foot level, is now being performed, with the objective of prospecting the vein at greater depth.

The Tom Reed mine is reported to have produced $8,947,855 in gold and silver and paid over $3,000,000 in dividends from April 1, 1908, to January 1, 1921.

Union Pass District.—The Katherine Gold Mining Co. and the Katherine Extension Mining Co. did considerable development work in 1921. Other companies prospecting in the neighborhood were the Treasure Vault, Rand Gold, Revenue, Gold Chain, Adams, and Big Four.

[17] Tom Reed Gold Mines Co. Fourteenth Ann. Rept., for year ending Apr. 1, 1922.

Wallapai district (Cerbat, Chloride, Kingman, Mineral Park, and Stockton Hill).—Six producers in the Wallapai district reported an output of 10,206 tons of ore, containing $20,876 in gold, 82,947 ounces of silver, 15,855 pounds of copper, and 278,321 pounds of lead, valued in all at $118,393. All the ore except 206 tons of smelting grade was treated in concentration plants. The principal producer was the C. O. D. mine, equipped with a new gravity-concentration plant and a flotation unit for treating 100 tons of ore daily. The ore contains galena, pyrite, and sphalerite in a siliceous-gangue and occurs in narrow, short lenses in fault fissures in granite. The mine is opened by a 500-foot shaft and has about 2,000 feet of drifts. Operations at the mill began in March and continued to the end of 1921. Kingman, 18 miles from the mine, is the loading station. A small lot of sulphide lead ore was shipped from the Kingman Consolidated property, which was under development. The mine is estimated to contain 300,000 tons of ore said to assay 10 ounces of silver, 10 per cent of lead, and 5 per cent of zinc. A small lot of silver ore, carrying gold and a little copper, was shipped from the Dardanelles mine.

Weaver district (Mocking Bird and Virginia).—Gold ore from the Zerolene group was treated in a 3-stamp amalgamation mill. The property is developed by several shallow cuts.

PIMA COUNTY.

Mine production in Pima County, Ariz., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	36	1,777,309	$4,699	36,147	44,854,649	209,989	$8,314,153
1921	16	929,455	2,645	2,247	20,332,938	30,166	2,629,199
Decrease, 1921	20	847,854	2,054	33,900	24,521,711	179,823	5,684,954

[a] Includes placer production.

The value of all metals produced in Pima County decreased in 1921, and the largest decrease was in the output of copper from the low-grade disseminated ores produced in the Ajo district. Ore of shipping grade aggregated 1,235 tons, valued at $26,142, or $21.17 a ton. At milling plants 21 tons of ore yielded gold and silver bullion having a total value of $435. The placer output amounted to $1,605 in gold and 16 ounces of silver.

Ajo district.—Most of the ore produced from the New Cornelia property in 1921 came from the open pit and was treated in the 5,000-ton plant at Ajo. The leaching is done with sulphuric acid, and the copper is precipitated electrolytically. Part of the copper was shipped, but most of it was stored in the company's warehouse. The total dividends paid by this company to date amount to $1,350,000. No dividends were paid in 1921. In 1921 the output of the New Cornelia mine[18] amounted to 20,198,382 pounds of copper, compared with 40,104,493 pounds in 1920. From this property

[18] New Cornelia Copper Co. Ann. Rept. for year ending Dec. 31, 1921.

931,051 tons of ore, which came principally from steam shovel operations and averaged 1.44 per cent of copper, was delivered to the crushing plant. The company report contains the following notes:

> The soluble copper in the ore was 1.308 per cent; insoluble copper 0.132 per cent. The proportion of insoluble copper has increased since 1920 from 8.46 per cent to 9.16 per cent. The gradual increase of insoluble copper in the ore is brought about by our mining operations approaching the line between the carbonate and sulphide ore bodies in various parts of the mine. The estimated reserve tonnage of carbonate ore as of December 31 is 7,532,175 tons of 1.48 per cent ore. * * *
>
> On account of the small production, it was possible to more than double the time of leaching. This made it possible to decrease the strength of acid in the leaching solution, which caused less impurities to go into solution, and thus cut down the acid consumption to such a degree that very little new acid had to be added. This was one of the important factors in bringing about the low operating cost. Also, as in 1920, practically all of the cement copper was returned to the solutions and reprecipitated as electrolytic copper. The flexibility of the Ajo process has been shown by the fact that the changes in rate of production have not materially affected the recovery of acid-soluble copper in the ore. * * *
>
> During the year 1921 experiments were carried on with a view to making finished copper products by electrolysis directly from the leaching solutions. While not yet ready for commercial application, these experiments have been most promising. They have shown that copper of high quality, both chemical and physical, can be deposited directly from the impure solutions, without further melting or refining.

Amole district.—Several small lots of ore from the Old Mission and Arizona properties were shipped to the smelter after being tested in the laboratory. The ore contains silver with a little gold, and the mines are five miles from Tucson.

Arivaca district.—Two small lots of lead ore, containing silver and gold, were shipped from prospects in the Arivaca district.

Cobabi district (Comobabi).—The Little Mary group, in the Comobabi Mountains, 9 miles north of Sells post office, produced copper-lead ore. In the last five years several lots of ore averaging $9.60 in gold and 24.4 ounces of silver to the ton, 31.5 per cent of lead, and 7.55 per cent of copper have been shipped. In 1921 a small jig mill, of about 5 tons capacity, was used in concentrating the ore.

Greaterville district.—The placer output in the Greaterville district in 1921 was estimated at $1,511 in gold and silver. There was also a small lot of lead product shipped from an unknown property.

Pima (Olive, San Xavier, and Twin Buttes) district.—The output of the Pima district in 1921 was very small, compared with that of 1920. Only 11 tons of lead ore was shipped, and about 20 tons of ore from the Keystone property was tested in a milling plant and produced some gold bullion.

Silver Bell district.—The principal operations in the Silver Bell district were carried on by the El Tiro Leasing Co., which suspended shipments the first of April, when the copper smelters were closed. The average content of the ore shipped, which was a carbonate, was between 8.5 and 9.45 per cent of copper, less than half an ounce of silver, and a trace of gold. One small lot of oxidized copper ore, containing silver, was produced in the course of development at the Silver Hill mine, which is opened by an inclined shaft 439 feet deep.

PINAL COUNTY.

Mine production in Pinal County, Ariz., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ozs.*	*Pounds.*	*Pounds.*	
1920	30	1,831,676	$107,006	432,283	57,070,320	129,254	$11,089,473
1921	16	430,943	[a] 23,584	[a] 108,078	12,388,772	96,191	1,734,143
Decrease, 1921	14	1,400,733	83,422	324,205	44,681,548	33,063	9,355,330

[a] Includes placer production.

Most of the ore produced in Pinal County came from the mines at Ray. Nearly all of it, or 425,247 tons, was of concentrating grade and produced 41,010 tons of concentrates, most of which was copper concentrate. Only a small quantity of siliceous concentrate was shipped. The ores of smelting grade aggregated 5,689 tons. A small amount of placer bullion was reported by one operator in 1921.

Bunker Hill district (Copper Creek).—One lot of lead ore, containing silver, was shipped to the smelter at El Paso from the Blue Bird or Thornwood property.

Casa Grande district.—Several shipments of lead ore are credited to the Casa Grande district in 1921. The largest producer was the Vekol property, 22 miles south of Casa Grande, a station on the Southern Pacific Railroad. A small lot of ore, which assayed 10.8 ounces of silver and 29.8 per cent of lead, came from the southwestern mining claims.

Mineral Creek district (Ray and Kelvin).—The mines of the Mineral Creek district produced 408,588 tons of ore in 1921, compared with 1,725,277 tons in 1920. The ore was principally from the Ray Consolidated property and was treated in the concentration mill at Hayden. A small lot of lead ore was reported from the Ray Silver-Lead property.

During the first three months of 1921 the Ray Consolidated Copper Co. conducted operations at reduced capacity. Owing to the demoralized condition of the copper market, the mine was closed as promptly as a clean-up of the mill could be accomplished after the end of the first quarter. The operating results given in the following paragraphs[19] do not compare favorably in either production or costs with those of other years.

There was shipped to the mill at Hayden 349,496 tons of concentrating ore averaging 1.65 per cent copper, and to the smelter 2,327 tons of ore averaging 3.10 per cent copper for fluxing purposes. * * *

The mining cost for the year was $1.31 per ton, exclusive of depreciation, as compared with $1.79 per ton for the previous year, in which is included $0.06 for depreciation. Of the year's cost, $0.04 per ton was due to coarse crushing and loading, leaving the net mining cost $1.27 per ton. The lower cost is due, in part, to the larger percentage of the tonnage obtained from reserve drawing. * * *

The total ore milled for the year was 406,172 dry tons, corresponding to a daily average of 5,802 tons, as compared with 1,706,928 dry tons during 1920. The total amount of ore milled since the beginning of operations and to the end of 1921 was 23,928,300 tons, averaging 1.68 per cent copper. The average grade of ore milled for 1921 was 1.65 per cent of copper, as compared with 1.72 per cent for 1920. The

[19] Ray Consolidated Copper Co. Thirteenth Ann. Rept., for year ending Dec. 31, 1921.

average recovery was 77.82 per cent of the entire copper content, equivalent to 25.62 pounds of copper per ton, as compared with 28.20 pounds of copper per ton for the previous year.

The concentrate production for the year was 34,510 tons containing an average of 15.08 per cent of copper. * * *

The recovery of copper occurring in the form of sulphides was 89.42 per cent, while the recovery of the carbonates and other oxidized copper minerals, which are not readily amenable to water concentration, was 29.66 per cent.

The cost of milling for the year, exclusive of depreciation, was $1.22 per ton, as compared with a cost for the previous year of $1.24, which included $0.13 for depreciation. The high cost of milling for both these years is due to the fact that the mill was operated at reduced capacity. * * *

The net production for 1921, after allowing for smelter deductions, was 10,110,131 pounds, as compared with 47,062,030 pounds for the previous year.

The average operating cost per pound of net copper produced from milling and direct smelting ore for the year was 16.41 cents. This cost does not take into account any credits for the value of the gold and silver, nor for miscellaneous income. By crediting the operating costs with the precious metal values and the proportion of miscellaneous income earned during the period of production, the net costs are reduced to 16.25 cents per pound.

The cost for the year 1921 includes all operating expenses and reserve for all taxes, together with the usual charge to cover extinguishment of mine development costs, which amounts to 15 cents per ton of ore mined, but does not include the amount set aside for depreciation nor for the shutdown expense.

The cost per net pound of copper produced in the year 1920 after crediting the value of gold and silver and miscellaneous income was 15.56 cents, of which 0.84 cents was for depreciation of plant and equipment. Exclusive of depreciation, the cost for the year 1920 was 14.72 cents per pound, as compared with 16.25 cents for the year 1921. This increase is due entirely to the greater cost per pound for State and county taxes, which was 1.16 cents for the year 1920, as compared with 1.88 cents for the year 1921.

The actual shutdown expense for the year not included in operating costs amounted to $225,923.30, exclusive of tax accruals and fixed and general expenses.

Pioneer district (Superior).—The principal producer in the Pioneer district in 1921 was the Magma Copper Co. Other properties from which shipments were made were the Silver King Extension and old Pioneer. Altogether 19,075 tons of milling ore was produced, and 2,664 tons of ore was shipped directly to the smelter. This output was principally copper ore, and only one lot of lead ore was produced. The Magma Copper Co. ceased production March 31.

The Magma mine [20] produced 21,445 tons of ore, averaging 5.25 per cent of copper, 3.15 ounces of silver, and 0.038 ounce of gold to the ton. From this output 2,238 tons of smelting ore was sorted from the conveyor belt, which averaged 16.45 per cent of copper, 7.74 ounces of silver, and 0.0904 ounce of gold. The remaining ore (19,207 tons) was of milling grade and assayed 3.94 per cent of copper, 2.61 ounces of silver, and 0.032 ounce of gold. Concentrate produced from this ore amounted to 6,129 tons and assayed 11.59 per cent of copper, 7.44 ounces of silver, and 0.10 ounce of gold. The average assay of the mill tailing was 0.36 per cent of copper and 0.35 ounce of silver. The annual report of the company contains the following notes:

The mill recovery was 93.834 per cent of the total copper in the mill heads. The total copper recovered, including ore obtained by hand-sorting, was 95.854 per cent of the copper content of the run-of-mine ore.

The net production, after deducting all smelting and refining losses, was 2,028,889 pounds of copper, 59,794.48 ounces of silver, and 818.88 ounces of gold. * * *

Owing to the demoralized condition of the copper market during 1921, all production was stopped March 31 and was not again resumed for the balance of the year.

[20] Magma Copper Co. Ann. Rept. for year ending Dec. 31, 1921.

Although production was stopped it was deemed advisable to continue development work. * * *

On the 1,800-foot level the main ore shoot has been developed for 1,550 feet in length, averages 20.8 feet in width, and assays 5.72 per cent copper and 2.64 ounces of silver. * *

On the 2,000-foot level the main ore shoot has been developed for a length of 950 feet, averages 21.8 feet in width, and assays 8.56 per cent copper and 4.50 ounces of silver. Some of the last crosscuts driven on the 2,000 level have given very interesting mineral results. In addition to the bornite and chalcopyrite, which have been the main copper mineralization for some time, these crosscuts are showing quite an appreciable amount of chalcocite and gray copper which are very likely of primary origin, the same as the chalcopyrite and bornite. * * *

It is interesting to compare the size of the ore body on the upper levels of the mine with the size of the main ore body on the lower levels of the mine, as represented by the 1,800 level. It will be recalled that above the 1,000 level the ore shoot was only 300 to 500 feet long and from 5 to 8 feet in width. On the new lower levels there will be mined for every vertical foot of ore shoot about ten times the amount of ore that was produced per foot on the upper levels. * * *

No. 2 shaft has been sunk to a depth of 2,451 feet and will be continued until a depth of 70 or 80 feet below the 2,500-foot level is reached.

Saddle Mountain district.—The ore produced in the Saddle Mountain district in 1921, amounting to 535 tons, was of smelting grade and contained $1,625 in gold, 26,004 ounces of silver, 590 pounds of copper, and 7,267 pounds of lead, valued in all at $28,032. The Adjust Mining Co., operating the Odell group, was the largest producer and shipped oxidized silver-lead ore to the El Paso smelter and silver ore, containing a little copper and gold, to the Hayden plant. This ore is packed by burros 2½ miles to Christmas, a station on the Arizona & Eastern Railway.

SANTA CRUZ COUNTY.

Sixteen producers in Santa Cruz County reported 1,043 tons of ore in 1921, or 10,574 tons less than was reported by 26 producers in 1920. Ore of shipping grade amounted to 695 tons, valued at $32,662, or $47 a ton. At milling plants 74 tons of lead concentrate containing silver and copper was made, valued at $1,494, or $20.19 a ton.

Harshaw district.—The output of six producers in the Harshaw district amounted to 478 tons of ore, of which 296 tons produced lead concentrate containing a little silver and copper. The remainder was ore of smelting grade containing lead, silver, and a little copper. Lead concentrates from the Flux mine, the result of operations of the year before, were shipped to a lead smelter, and crude lead-silver ore was produced from the Hardshell, Trench, and Patagonia properties.

Oro Blanco district.—A lessee working the Progressive mining claims treated some ore by cyanidation and shipped gold and silver bullion. This property is in California Gulch, 3 miles south of Ruby.

Patagonia district (Washington and Duquesne).—Two producers in the Patagonia district reported the output of 350 tons of ore, containing 2,975 ounces of silver, 67,689 pounds of copper, and 18,136 pounds of lead, valued in all at $12,523. All this ore was of smelting grade and was produced principally from the Duquesne mine. One small lot came from the Thessalia claim.

Tyndall (Aztec) district.—Five producers in the Tyndall district reported 153 tons of ore, containing principally silver, valued at $9,467. The producers were the Twentieth Century, Royal Blue, Silver Hill, Eureka, and Black Jack properties. The Eureka claim

is part of the Baca Float land grant, which covers a large part of the Tyndall district.

Wrightson district.—A concentration mill was in course of construction in the Wrightson district to treat ore from the Draga Z. claim, 7 miles north of Patagonia. A small test lot of lead-silver ore was shipped to the El Paso smelter in 1921.

YAVAPAI COUNTY.

Mine production in Yavapai County, Ariz., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds*	*Pounds.*	
1920	73	1,038,243	$659,541	1,555,075	114,937,080	238,296	1,457,296	$23,640,101
1921	51	191,964	112,984	383,193	26,576,298	172,150	.....	3,932,266
Decrease, 1921	22	846,279	546,557	1,171,882	88,360,782	66,146	1,457,296	19,707,835

[a] Includes placer production.

The total value of the metals reported included, besides gold, $383,193 for silver, $3,428,342 for copper, and $7,747 for lead. No zinc was reported in 1921. Most of the first-class ore shipped to smelters consisted of copper ores (189,503 tons, all of which was sulphide). The average value of the smelting ores was $20.50 a ton. Concentrates amounting to 151 tons, derived from 1,505 tons of ore, were valued at $27,051, or $179.15 a ton. The placer output amounted to $5,855 in gold and 36 ounces of silver, against $3,145 in gold and 4 ounces of silver in 1920.

Big Bug district.—Five producers in the Big Bug district reported 1,607 tons of ore, the larger part of which was of concentrating grade containing lead. Altogether the ore produced contained $1,800 in gold, 23,123 ounces of silver, 981 pounds of copper, and 102,226 pounds of lead, valued in all at $29,649. Some placer mining was carried on in the district, and bullion shipped from three sources contained $1,518 in gold and 11 ounces of silver. The largest ore output came from the property of the Arizona National Mining Co., which hauls its ore and concentrate 2 miles to Iron King siding, on the Santa Fe, Prescott & Phoenix Railroad. The property has a 50-ton flotation plant, which was operated during part of 1921.

The Humboldt smelter was closed, and a receivership for the Consolidated Arizona Smelting Co. was granted in the Federal court at Tucson on December 24, 1920. The smelting plant was not operated in 1921. According to a statement [21] made by the general manager of the property, from the first part of 1915 until the end of 1919 the company produced 34,000,000 pounds of copper from its own mines, the Blue Bell and De Soto. The net cost of production, after crediting gold and silver, was 15 cents a pound. The earnings of the company, beginning with 1915, were used to pay a part of the debt, to replace and build the plant, which cost $1,800,000, and to pay dividends. The company never succeeded in getting out of debt.

[21] Min. and Sci. Press, vol. 122, p. 432, Mar. 26, 1921.

The Southwest Metals Co. is expected to assume the property and liabilities of the Consolidated Arizona Smelting Co.

Black Canyon district.—A small lot of lead-silver ore from the Brooks mine and similar ore from the properties of the Black Canyon, Silver Cross, and Golden Belt mining companies made up the total output of the Black Canyon district in 1921.

Black Hills district.—A little gold bullion was recovered from ore produced at the Prescott mine, operated by the Buckeye Hope Mining Co. The ore was treated at the Verde Inspiration amalgamation and concentration mill. At the Yeager Canyon property of the Shannon Copper Co. all the ore mined was put on the stock pile. This mine is opened by a 1,300-foot inclined shaft. Operations were discontinued September 21, 1921. The loading station for this ore is at Yeager siding, 7 miles from the mine, on the Santa Fe branch to Prescott.

Cherry Creek district.—A small lot of gold bullion was recovered from ore milled in the Cherry Creek district.

Copper Basin district.—Two small lots of ore of smelting grade, containing principally silver, were shipped from claims in the Copper Basin district.

Eureka district (Hillside).—The Mary Louise group produced oxidized lead ore, which was hauled 29 miles to Hillside, Ariz., and shipped to the smelter at El Paso, Tex.

Hassayampa district.—Four producers in the Hassayampa district reported the production of 158 tons of gold and silver ore, containing $2,393 in gold, 1,093 ounces of silver, and a little lead, valued in all at $3,617. Most of the ore was of milling grade from the Westerner prospect. Gold bullion was shipped, but the concentrates were stored. Gold and silver ore was also milled from the Stranger claim, and one lot of silver-lead ore from the Silver Prince property was shipped to El Paso, Tex. At the Frenchman property, 2 miles southwest of Venezia, ore treated by arrastre produced gold bullion.

Peck district.—A small lot of silver ore from the Swastika property was shipped to the Hayden smelter. The 50-ton cyanide plant under construction on this property was not completed in 1921. Work at the Peck mines was confined to testing the ore by flotation.

Tiger district (Crown King and Harrington).—The Crown King tailing dump was the source of some gold bullion, and an arrastre at Humbug treated gold ore from the Herald claim. Several small lots of lead-silver ore were shipped from the Cougar claim.

Tip Top district.—A small lot of copper ore was shipped to the smelter from the Davis No. 3 claim.

Turkey district.—The output of 100 tons of ore by three producers in the Turkey district contained $434 in gold, 13,354 ounces of silver, 20,700 pounds of lead, and a little copper, valued in all at $14,845. Most of the ore came from the War Eagle claim, shipped in five small lots to El Paso and Hayden. The ore contained from 67 to 183 ounces of silver a ton and from 9 to 22 per cent of lead. Copper ore was shipped from the Secundus property.

Verde district (Jerome).—Three producers in the Verde district reported the output of 189,474 tons of ore, containing $98,421 in gold, 319,646 ounces of silver, and 26,567,602 pounds of copper, valued in all at $3,845,288, or $20.29 a ton. The larger part of the output was from the United Verde property, followed by the United Verde Exten-

sion. A small lot of silver ore containing copper was shipped from the Shea property.

The smelting plant of the United Verde Extension Co.[22] was closed May 1 owing to the condition of the copper market. During the first four months of 1921 the ore smelted amounted to 53,643 dry tons, yielding bullion which contained 12,498,005 pounds of copper, 2,328 ounces of gold, and 112,864 ounces of silver, valued in all at $2,043,519. The mining cost per pound of copper was 5.9 cents; smelting 3.17 cents; freight on ore 0.22 cent; freight on bullion, refining and selling, 3.55 cents; and other expenses 0.62 cent, or a total of 13.46 cents. These costs do not include depreciation, reserve to return capital (depletion), or taxes. On December 31 the company had 6,955,942 pounds of copper on hand. An estimate of ore reserves is given in the company report as 1,102,000 tons, averaging 11.75 per cent of copper, 0.023 ounce of gold, and 2.22 ounces of silver to the ton. Dividends paid to stockholders in 1921 amounted to $1,050,000.

The United Verde mine is opened by five vertical shafts, Nos. 2, 3, 4, 5, and 6, of which No. 3 is the deepest. It is 1,986 feet deep and has three compartments. According to a recent article,[23] the mine is well developed, practically to the 2,500-foot level, but no ore has been taken out below the 1,800-foot level. For the convenience of smelter operation, all the ores mined are divided into four classes, known as oxide ore, iron ore, silica ore, and converter ore. The oxide ore will be mined later by steam shovel. In all the work the different classes of ore are handled separately and the classification depends upon the analysis. The oxide ores are mined above the 160-foot level, in the oxidized zone, and contain but a small amount of copper, 0.2 ounce of gold, and 8 ounces of silver. The iron ore is that mined from the stopes within the massive sulphide areas; the only difference between that and the silica ore is that if the silica content is over 15 per cent the ore is called silica ore. The ore coming from the black schist stopes and from the quartz porphyry stopes is also classed as silica ore. The name "silica ore" is somewhat of a misnomer, as in much of it the iron content is higher than the silica content. The converter ore is high in silica and is mined primarily as a converter flux and for fettling in the reverberatories. The main supply of this ore comes from a low-grade enrichment ore body in the quartz porphyry, located apart from the main ore bodies and extending from the 160-foot to the 600-foot level. Small quantities are obtained from other sources.

Since 1894 there have been scattered fires in the United Verde mine [24] from the fifth level to the surface. The ore bodies above the fifth level, however, contained considerable high-grade ore that could not be abandoned. A steam shovel has been in operation since 1919 cleaning away the overburden, and starting at the 300-foot level it will mine down as an open pit to the 400-foot level, stripping enough of the hill to make the cut safe.

Walker (Lynx Creek) district.—Lead ore from the Penn Arizona property and gold bullion recovered from ore produced from the Blue John property made up the output of the deep mines of the Walker district, which was valued at $2,890. In addition to this three placer producers reported $1,096 in gold and 8 ounces of silver.

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[22] United Verde Extension Mining Co. Ann. Rept. for year ending Dec. 31, 1921.
[23] Arizona Min. Jour., Aug. 1, 1922.
[24] Steam-shovel operations at the United Verde mine: Min. and Sci. Press, vol. 122, p. 453, Apr. 2, 1921.

Walnut Grove district.—The Zonia property [25] was exploited by the Inspiration and Anaconda companies in 1921. A shaft was sunk 874 feet, and several crosscuts were driven. As the result was disappointing, work was stopped and the options on the property were surrendered.

YUMA COUNTY.

The total value of the gold, silver, copper, and lead produced in Yuma County was $29,563, against $694,274 in 1920. The placer production was valued at $2,091 in 1921.

Castle Dome district (Dome).—From the Purisima property lead concentrate and crude ore containing silver were shipped to the smelter. A small quantity of gold and silver bullion was shipped to the mint from one other property in the Castle Dome district.

Planet district (Swansea).—The Swansea lease, operating on the Clara property, produced copper concentrate and crude ore, probably from former operations, as the company reported that there was no production in 1921.

Plomosa district.—One quartz property and the placers in the Plomosa district produced bullion containing $1,367 in gold and 7 ounces of silver.

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[25] Inspiration Copper Co. Ann. Rept. for year ending Dec. 31, 1921.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH.

(MINES REPORT.)

By V. C. Heikes.[1]

PRODUCTION.

SUMMARY.

In 1921 the output of ores of gold, silver, copper, lead, and zinc from mines in Utah decreased 69 per cent in quantity, and the value of the metals recovered decreased 56 per cent from 1920. The greatest decrease in quantity was in that of copper, which also showed a decline of 81 per cent in value; lead decreased 64 per cent in value, zinc 99 per cent, silver 14 per cent, and gold 12 per cent.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1920–21.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	164	6,800,180	$2,014,556	13,106,976	116,931,238	140,838,113	8,157,739	$49,744,334
1921	138	2,137,522	1,769,905	12,251,998	30,891,403	89,187,269	69,390	22,023,790
Decrease, 1921	26	4,662,658	244,651	854,978	86,039,835	51,650,844	8,088,349	27,720,544
1864–1921[b]	.....	.....	102,012,435	416,485,059	2,461,216,491	4,496,462,814	223,015,179	1,119,140,386

[a] Includes small placer production.
[b] The total by years to the end of 1917 appears in U. S. Geol. Survey Prof. Paper 111, p. 127, 1920.

The published dividends paid by 11 producers in 1921 amounted to $4,840,167, which gives a total paid to stockholders since mining became profitable of $226,599,433.

ORE.

Of the various kinds of ore mined in Utah in 1921 copper ore was mined in greatest quantity, followed by the lead-silver ores and the dry or siliceous ores of silver. The total values of the ores, not shown in the accompanying table, are as follows: Dry gold ore, $6,429; dry gold and silver ore, $511,186; dry silver ore, $6,751,978; copper ore, $4,062,887; lead ore, $10,605,262; and copper-lead ore, $85,633. The small placer output valued at $415, completes the total of the State which amounts to $22,023,790.

[1] Valuable assistance in the preparation of the report and the compilation of statistical tables was rendered by B. N. Patchell, of the United States Geological Survey.

Ore and metals produced in Utah in 1921.

Source of production.	Ore.		Gold.		Silver.	
	Short tons.	Per cent.	Fine ounces.	Per cent.	Fine ounces.	Per cent.
Dry gold ore	69		266.69	0.31	628	0.01
Dry gold and silver ore	33,616	1.57	11,769.97	13.75	222,304	1.81
Dry silver ore	342,787	16.04	17,517.44	20.46	5,865,703	47.88
Copper ore	1,357,857	63.53	14,384.74	16.80	229,556	1.87
Lead ore	401,429	18.78	41,628.44	48.62	5,893,497	48.10
Copper-lead ore	1,764	.08	31.84	.04	40,309	.33
Total deep mines	2,137,522	100.00	85,599.12	99.98	12,251,997	100.00
Total placer mines			20.03	.02	1	
Total, deep and placers, 1921	2,137,522	100.00	85,619.15	100.00	12,251,998	100.00
Total, deep and placers, 1920	6,800,180		97,454.15		13,106,976	
Decrease, 1921	4,662,658		11,835.00		854,978	

Source of production.	Copper.		Lead.		Zinc.	
	Pounds.	Per cent.	Pounds.	Per cent.	Pounds.	Per cent.
Dry gold ore			6,403	0.01		
Dry gold and silver ore	21,545	0.07	951,033	1.07		
Dry silver ore	1,350,109	4.37	7,777,627	8.72		
Copper ore	27,321,481	88.44	255,567	.28		
Lead ore	2,088,255	6.76	79,519,436	89.16	69,390	100.00
Copper-lead ore	110,013	.36	677,203	.76		
Total deep mines, 1921	30,891,403	100.00	89,187,269	100.00	69,390	100.00
Total deep mines, 1920	116,931,238		140,838,113		8,157,739	
Decrease, 1921	86,039,835		51,650,844		8,088,349	

SILVER ORE.

The dry or siliceous silver ores were mined by 40 producers in 1921, against 45 producers in 1920. These ores averaged $1.06 in gold, 17.11 ounces of silver, 3.94 pounds of copper, and 22.69 pounds of lead to the ton. The Tintic district, in Juab and Utah counties, had the largest number of silver-ore producers—25, who reported 232,228 dry tons, and 16 of these producers shipped 107,441 dry tons to chloridizing-roasting plants in the district, at Silver City and Warm Springs (Harold). The largest producers of silver ore in the Tintic district were the Chief Consolidated and Tintic Standard mines, at Park City the Park-Utah, Silver King Coalition, and Ontario mines, in Box Elder County the Vipont Silver mine, and at Bingham the Dalton & Lark mine (Bingham Mines Co.).

Content of dry silver ores sold or treated in Utah in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Beaver	295	9.66	4,862	1,035	1,903
Box Elder	43,219	1,331.63	716,809	1,938	7,306
Juab	124,410	11,265.85	2,533,329	423,762	2,678,604
Salt Lake	25,910	1,694.27	108,781	257,695	268,320
Summit	22,097	805.30	420,865	111,793	1,364,090
Tooele	11,559	.09	22,580	3,194	329,889
Utah	107,818	1,690.43	1,680,133	512,692	2,832,515
Wasatch	7,438	720.12	377,812	38,000	295,000
Washington	41	.09	532		
	342,787	17,517.44	5,865,703	1,350,109	7,777,627

COPPER AND COPPER-LEAD ORES.

Copper ore from 17 producers represented 63 per cent of the total ore output. The average content of this ore was 0.01 ounce of gold, 0.17 ounce of silver, and 20.2 pounds of copper, and the average value was $2.99 a ton. Salt Lake County was credited with the largest output in 1921, chiefly from the Utah Copper property at Bingham.

The small quantity of copper-lead ore produced averaged 0. 02 ounce of gold and 22.85 ounces of silver a ton, 3.12 per cent of copper and 19.2 per cent of lead and was valued at $48.54 a ton. This ore came chiefly from the Ophir and Little Cottonwood districts.

Content of copper ores sold or treated in Utah in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Juab	2,653	630.22	49,693	274,412	25,714
Piute	30	39.00	854	2,153	.....
Salt Lake	1,354,937	13,520.66	176,363	27,024,637	217,108
Tooele	85	.31	1,627	5,630	5,691
Utah	152	194.55	1,019	14,649	7,054
	1,357,857	14,384.74	229,556	27,321,481	255,567

LEAD ORE.

The output of lead ore by 100 producers was valued at $10,605,262. It averaged 0.10 ounce of gold and 14.68 ounces of silver a ton, 0.26 per cent of copper, 9.90 per cent of lead, and a little zinc. The total average value of all the metals was $26.42 a ton. In 1920 there were 109 producers of lead ore whose output was valued at $18,785,116, or $33.55 a ton.

Content of lead ores sold or treated in Utah in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Beaver	6,710	242.20	76,032	27,123	1,269,228	.....
Juab	76,635	4,209.78	2,448,008	123,269	24,481,741	.....
Piute	1,974	2,729.56	63,315	6,970	646,593	.....
Salt Lake	179,470	31,303.04	1,003,137	1,017,402	29,051,505	69,390
Summit	51,726	1,467.17	905,850	295,711	9,143,604	.....
Tooele	4,460	120.40	36,208	21,049	1,601,678	.....
Utah	31,101	969.04	878,216	236,710	6,427,968	.....
Wasatch	49,347	587.25	482,709	360,021	6,888,528	.....
Weber	6	.....	22	.....	8,591	.....
	401,429	41,628.44	5,893,497	2,088,255	79,519,436	69,390

METALLURGIC INDUSTRY.

Concentrates of all kinds produced in Utah in 1921 aggregated 133,807 tons and contained 49 per cent of the gold, against 48 per cent in 1920; 14 per cent of the silver, against 16 per cent; 80 per cent of the copper, against 88 per cent; and 32 per cent of the lead, against 29 per cent. All the zinc produced in 1921 was contained in concentrates.

Mine production of metals from Utah concentrates in 1921.

By counties.

County.	Ore to concentrating mills.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beaver	3,160	395	5.00	19,727	1,360	242,711	.....	$30,927
Box Elder	43,096	3,046	1,256.63	673,142	1,599	4,078	.....	699,508
Juab	1,056	172	24.00	13,830	15	90,882	.....	18,418
Piute	.....	2,229	4,950.00	103,174	21,545	951,033	.....	251,075
Salt Lake	1,367,490	115,748	34,932.89	626,671	24,576,461	20,926,739	69,390	5,464,333
Summit	19,835	2,990	155.14	69,809	10,555	1,460,323	.....	140,093
Tooele	2,490	830	4.15	9,847	18,999	218,247	.....	22,205
Utah	76	19	1.50	402	260	11,400	.....	980
Wasatch	40,276	8,378	302.60	211,514	115,379	5,019,330	.....	458,523
	1,477,479	133,807	41,631.91	1,728,116	24,746,173	28,924,743	69,390	7,086,662

By kinds of concentrates.

Dry or siliceous	.....	3,046	1,256.63	673,142	1,599	4,078	.....	$699,509
Copper	.....	58,068	7,040.76	65,890	23,933,710	.....	.....	3,298,884
Lead	.....	72,596	33,331.52	988,984	810,864	28,918,965	.....	3,083,962
Zinc	.....	97	3.00	100	.....	1,700	69,390	3,707

Average content.

Kind of concentrates.	Quantity.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine oz. per ton.*	*Fine oz. per ton.*	*Per cent.*	*Per cent.*	*Per cent.*	
Dry or siliceous	3,046	0.41	220.99	0.02	0.06	.....	$229.65
Copper	58,068	.12	1.13	20.61	.....	.....	56.81
Lead	72,596	.46	13.62	.56	19.92	.....	42.48
Zinc	97	.03	1.03	.....	.88	35.77	38.22
	133,807	.31	12.91	9.24	10.80	.02	52.96

Crude ore of all kinds shipped directly to the smelters amounted to 403,528 tons, or about 19 per cent of the total output, and produced 42 per cent of the gold in 1921, against 47 per cent in 1920; 76 per cent of the silver, against 79 per cent; 17 per cent of the copper, against 9 per cent; and 67 per cent of the lead, against 70 per cent.

Mine production of metals from Utah crude ore shipped to smelters in 1921.

By counties.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Beaver	3,634	238.46	57,435	26,798	1,028,420	$112,100
Box Elder	123	75.00	43,667	339	3,228	45,406
Juab	148,651	14,944.32	4,395,693	692,609	27,095,177	6,013,249
Piute	2,005	2,769.23	64,169	9,123	646,593	151,688
Salt Lake	85,513	11,592.93	679,292	3,140,325	8,678,271	1,714,563
Summit	46,338	2,117.33	1,256,906	396,949	9,047,371	1,759,013
Tooele	14,997	396.03	72,404	78,355	2,320,265	195,111
Utah	85,752	2,687.09	2,119,206	712,708	9,185,997	2,680,062
Wasatch	16,509	1,004.77	649,007	282,642	2,164,198	803,628
Weber	6	.....	22	.....	8,591	408
	403,528	35,825.16	9,337,801	5,339,848	60,178,111	13,475,228

Mine production of metals from Utah crude ore shipped to smelters in 1921—Continued.

By kinds of ore.

	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Dry or siliceous	192,278	15,216.10	4,127,691	1,168,828	7,709,812	$4,939,957
Copper	37,452	7,343.91	163,633	2,766,069	255,567	683,768
Lead	172,083	13,242.77	5,007,393	1,298,524	51,545,392	7,768,197
Copper-lead	1,715	22.38	39,084	106,427	667,340	83,306

Average content.

Kind of ore.	Quantity.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	
Dry or siliceous	192,278	0.08	21.47	0.30	2.00	$25.69
Copper:						
Oxidized	3,022	.21	21.40	5.34	.90	40.38
Sulphide	34,430	.19	2.87	3.55	.29	16.31
Lead:						
Oxidized	36,556	.11	26.05	.56	16.25	44.37
Sulphide	135,527	.06	29.92	.34	14.63	45.35
Copper-lead:						
Oxidized	1,333	.01	16.32	2.60	22.45	43.46
Sulphide	382	.02	45.36	4.85	9.00	66.41
	403,528	.09	23.14	.66	7.45	33.39

GOLD.

The mine production of gold decreased 12 per cent. Most of the gold came from ores mined at Bingham, in Salt Lake County; Juab and Piute counties were next in rank.

Most of the gold produced in Utah is a by-product of the copper and lead ores. The United States property, at Bingham, was the largest producer of gold in 1921; the Deer Trail property in Piute County was second; and the Utah Copper, Chief Consolidated, Eagle & Blue Bell, and Niagara mines followed in order.

SILVER.

The output of silver decreased 7 per cent. The largest output was from Juab County, followed by Utah, Summit, and Salt Lake counties.

Only one operator reported cyanidation of gold and silver ores, and no ore was treated by amalgamation in 1921. At Silver City a leaching mill using a chloridizing roast on custom ores recovers a rich silver bullion, from which 1,065,531 ounces was reported in 1921.

Five properties each produced more than 500,000 ounces of silver in 1921. The Chief Consolidated, in the Tintic district, ranked first, with an output of 3,122,099 ounces, followed by the Tintic Standard, in the same district; the Vipont Silver, in Box Elder County; the United States property, at Bingham; and the Eagle & Blue Bell, in the Tintic district.

COPPER.

The Bingham or West Mountain district, in Salt Lake County, produced the largest quantity of copper in 1921, followed by the

Tintic district, in Juab County, and the Park City region, in Summit and Wasatch counties.

Copper concentrates produced at milling plants contained 23,933,710 pounds; lead concentrates, 810,864 pounds; and dry or siliceous concentrates, 1,599 pounds. Crude ore shipped to smelters contained 5,339,848 pounds of copper, against 11,228,742 pounds in 1920. The crude copper ore smelted contained 2,766,069 pounds of which 2,443,398 pounds was from sulphide ores and 322,671 pounds from oxidized ores. Lead ores smelted produced 1,298,524 pounds of copper, the sulphide ores yielding 925,720 pounds and the oxidized ores 372,804 pounds. Copper-lead ores, which were mostly oxidized, contained 106,427 pounds of copper. The dry or siliceous ores, used principally for fluxing at smelting plants, contained 1,168,828 pounds, against 1,946,451 pounds in 1920. The low-grade copper-bearing disseminated ores concentrated and leached contained 24,496,167 pounds of copper, against 104,005,479 pounds in 1920.

The leading producers of copper, named in order of production, were the Utah Copper Co. (reporting 24,511,593 net pounds[2]), the Montana-Bingham, and the mines of the United States Smelting, Refining & Mining Co.

LEAD.

The output of lead decreased 37 per cent on account of the idleness of the Utah Apex mine, at Bingham, and the burning of the mill of the Silver King Coalition mine, at Park City.

The Bingham or West Mountain district produced 24,576,646 pounds, compared with 52,488,597 pounds in 1920. The greatest part of the production at Bingham came from the United States and Niagara mines. The Park City region produced 17,691,222 pounds, against 25,732,104 pounds in 1920; the Tintic district produced 36,315,543 pounds, against 41,240,223 pounds; the combined production of the Ophir and Rush Valley districts, in Tooele County, decreased from 9,190,635 pounds in 1920 to 2,173,809 pounds; and the output in Beaver County decreased from 2,808,314 to 1,271,131 pounds.

Ranking first in the output of lead was the property of the United States Mining Co., at Bingham, followed in order by the Chief Consolidated and Tintic Standard, in the Tintic district; the Judge and Silver King Coalition, in the Park City district; and the Victoria, in the Tintic district. Each of these was credited with producing more than 6,000,000 pounds of lead. Those following were the Niagara, Eagle & Blue Bell, Daly West, and Cardiff mines.

ZINC.

The zinc oxide plant of the Utah Zinc Co., near Murray, Utah, did not operate in 1921, but ore contracts were being arranged preparatory to operations in 1922. A description of the plant was given in the Mining and Scientific Press, November 27, 1920, page 759.

[2] Utah Copper Co. Seventeenth Ann. Rept., for year ending Dec. 31, 1921.

MINING INDUSTRY.

Early in 1921 practically all the large producers of copper ores were forced to suspend operations. The West Mountain or Bingham district suffered more than any other district in Utah. With the closing of a large number of mines, owing to the depression in the copper market the producers of siliceous lead-silver and gold-silver ores were seriously affected. As the smelters were unable to obtain ores of different character necessary for economical smelting, they exacted higher rates for treating the highly siliceous ores. At Garfield the operation of the copper plant was curtailed after the closing of the Utah Copper mills in April. However, with the stock of ore on hand and the siliceous gold-silver ores from the Tintic district and low-grade copper-iron sulphides from Bingham (used as a flux), smelting was continued in a small way throughout 1921.

Announcement was made on June 5 of a reduction from $22 to $16.50 a ton in freight rates on bullion from Utah smelting points to the Atlantic seaboard. This was a return to the old rates that were increased August 26, 1920. At that time the smelting companies upon purchasing ore immediately deducted approximately 1 cent an ounce on silver and a quarter of a cent a pound on lead contents to cover the additional freight on bullion.

In July the Garfield plant increased its ore consumption to 500 tons a day as a result of working out a high-silica smelting charge. The silica slag was said to average about 48 per cent of silica, an increase of 8 per cent from the content by former practice.

At International the copper plant remained closed throughout the year, and on July 5 both the lead furnaces were shut down. The Midvale plant of the United States Co. had from three to four lead furnaces in blast, and one furnace was used on matte concentration. At Murray the American Smelting & Refining Co. reduced its operations in October from four to two blast furnaces.

Smelting works in Utah, 1921.

Company.	Location of works.	Blast furnaces.		Reverberatories.		Converters.	
		Number.	Annual capacity (tons of ore).	Number.	Annual capacity (tons of ore).	Number.	Annual capacity (tons of ore).
American Smelting & Refining Co.	Murray (lead)	8	700,000				
Do	Garfield (copper)	4	800,000	7	1,300,000	9	160,000
International Smelting Co	Tooele (copper)[a]			5	500,000	5	50,000
Do	Tooele (lead)[b]	5	600,000				
United States Smelting, Refining & Mining Co	Midvale (lead)	7	530,000				

[a] Idle.

[b] Idle the latter part of 1921.

PRODUCTION BY COUNTIES.

GENERAL FEATURES.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1921.

County.	Gold.					Silver.	
	Placers.		Deep mines.		Total value.	Fine ounces.	Value.
	Fine ounces.	Value.	Fine ounces.	Value.			
Beaver			251.84	$5,206	$5,206	80,894	$80,894
Box Elder			1,331.62	27,527	27,527	716,809	716,809
Grand	1.50	$31			31		
Juab			16,105.87	332,938	332,938	5,031,030	5,031,030
Piute			14,539.25	300,553	300,553	286,473	286,473
Salt Lake	.92	19	46,536.41	961,993	962,012	1,307,382	1,307,382
Summit			2,272.46	46,976	46,976	1,326,715	1,326,715
Tooele			400.16	8,272	8,272	82,251	82,251
Uintah	17.61	364			364	1	1
Utah			2,854.03	58,998	58,998	2,559,368	2,559,368
Wasatch			1,307.38	27,026	27,026	860,521	860,521
Washington			.10	2	2	532	532
Weber						22	22
	20.03	414	85,599.12	1,769,491	1,769,905	12,251,998	12,251,998

County.	Copper.		Lead.		Recoverable zinc.		Total value.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
Beaver	28,158	$3,632	1,271,131	$57,201			$146,933
Box Elder	1,938	250	7,306	329			744,915
Grand							31
Juab	821,443	105,966	27,186,059	1,223,373			6,693,307
Piute	30,668	3,956	1,597,626	71,893			662,875
Salt Lake	28,342,266	3,656,152	29,619,285	1,332,868	69,390	$3,469	7,261,883
Summit	407,504	52,568	10,507,694	472,846			1,899,105
Tooele	97,354	12,559	2,538,512	114,233			217,315
Uintah							365
Utah	764,051	98,563	9,267,537	417,039			3,133,968
Wasatch	398,021	51,345	7,183,528	323,259			1,262,151
Washington							534
Weber			8,591	386			408
	30,891,403	3,984,991	89,187,269	4,013,427	69,390	3,469	22,023,790

Ore sold or treated, number of deep mines producing, and value of ores in Utah in 1920 and 1921.

County.	Ore sold or treated, 1921 (short tons).		Number of deep mines producing.		Average total value per ton.[a]		Average value per ton in gold and silver.[a]	
	Total.	Increase or decrease.	1920	1921	1920	1921	1920	1921
Beaver	7,005	−8,030	16	11	$30.17	$20.98	$14.65	$12.29
Box Elder	43,219	+10,411	3	1	18.46	17.24	18.12	17.22
Iron		−17	1		41.00		41.00	
Juab	203,698	−52,594	31	30	32.32	32.86	21.96	26.33
Morgan		−15	1		46.20		9.47	
Piute	35,621	+10,657	5	4	21.61	18.61	18.76	16.48
Salt Lake	1,560,766	−4,549,395	52	45	4.72	4.65	.54	1.45
Summit	73,823	−58,012	11	8	30.56	25.73	18.40	18.61
Tooele	17,487	−88,339	27	19	15.71	12.43	5.23	5.18
Utah	139,071	+58,044	10	9	46.93	22.54	31.26	18.83
Wasatch	56,785	+14,751	3	5	36.10	22.23	13.58	15.63
Washington	41	−125	1	1	110.83	13.02	.43	13.02
Weber	6	+6		1		68.00		3.67
	2,137,522	−4,662,658	161	134	7.31	10.30	2.40	6.56

[a] Value per ton, placer product excluded.

BEAVER COUNTY.

Mine production in Beaver County, Utah, 1920–21.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	16	15,035	$14,700	188,628	47,414	2,808,314	.....	$453,694
1921	11	7,005	5,206	80,894	28,158	1,271,131	.....	146,933
Decrease, 1921...	5	8,030	9,494	107,734	19,256	1,537,183	.....	306,761
Total, 1860–1921.	.....	.....	856,697	22,070,852	52,888,104	426,886,910	36,070,774	52,442,565

Preuss district.—A small lot of lead ore containing silver was shipped from the Galena property in 1921.

Rocky district.—The Montreal mine, operated by the Milford Copper Co., is opened by a vertical shaft 120 feet deep and by drifts approximately 2,000 feet long. Considerable iron ore, carrying an average of 52.19 per cent of iron, 0.7 per cent of manganese, 0.10 ounce of silver, and 0.15 per cent of copper, was produced. The ore is sold at a flat rate to the smelter for flux and is not included in the totals of this report.

San Francisco district (Frisco and Newhouse).—Two producers in the San Francisco district reported the output of 6,016 tons of ore, of which 3,160 tons produced concentrates and 2,645 tons was shipped directly to smelters. There were 211 tons shipped for treatment by the Tintic Milling Co. at Silver City. The total output of the district contained $4,287 in gold, 70,648 ounces of silver, 22,044 pounds of copper, and 884,587 pounds of lead, valued in all at $117,585. The Horn Silver and Carbonate and Rattler mines, both at Frisco, were the only producers.

Star and North Star districts.—Eight producers in the Star district reported 968 tons of ore, containing $904 in gold, 10,039 ounces of silver, 5,741 pounds of copper, and 380,188 pounds of lead, valued in all at $28,792, or $29.74 a ton. The properties producing were the Gold Crown, Red Warrior, Wild Bill, Lady Bryan, Humboldt, Harrington-Hickory, and Hoosier Boy. Most of the ore produced was hauled 7 miles to Laho, a railroad siding on the Los Angeles & Salt Lake Railroad.

BOX ELDER COUNTY.

Ashbrook district (Vipont).—Concentrates were produced from siliceous silver ore from the property of the Vipont Silver Mining Co. The flotation mill, operated by electric power, has a daily capacity of 175 tons. The minerals argentite, sphalerite, native silver, and chalcopyrite have been noted. The ore occurs in irregular bunches of limestone. Development is carried on through a 3,000-foot adit, and the present depth reached on the vein is said to be 1,350 feet. The mill product is hauled 26 miles to Oakley, Idaho, a station on the Oregon Short Line Railroad.

Lucin district.—The Salt Lake Copper Co., the principal operator in the Lucin district, made geologic surveys and prepared for development, but no ore was shipped in 1921.

JUAB COUNTY.

Fish Springs district.—From the Utah, Carnation, and Galena properties lead-silver ore was shipped to the smelter. The Utah mine has a 150-ton concentration mill, in which ore from the waste dump was treated.

Tintic district.—All the mines of the Tintic district are reviewed under Juab County, although a number of important mines in the eastern part of the district are in Utah County.

Mine production in Tintic district, Utah, 1920–21.

County.	Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
			Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Juab	1920	29	251,657	$558,980	4,602,575	2,223,552	27,175,698	180,944	$8,173,634
	1921	27	203,057	332,881	5,020,368	821,315	27,102,709	.....	6,678,821
Utah	1920	7	80,978	44,710	2,282,165	779,797	14,064,525	.....	3,800,915
	1921	5	138,690	54,893	2,556,834	748,737	9,212,834	.....	3,122,891
Total	1920	36	332,635	603,690	6,884,740	3,003,349	41,240,223	180,944	11,974,549
	1921	32	341,747	387,774	7,577,202	1,570,052	36,315,543	.....	9,801,712
Total, 1869–1921			34,762,886	153,195,097		185,886,846	884,720,713	17,342,988	223,398,578

Total dividends, 1869–1921, $36,836,342.

The values of the metals for 1921 not shown in this table are as follows: Gold, $387,774, against $603,690 in 1920; silver, $7,577,202, against $7,504,367; copper, $202,537, against $552,617; lead, $1,634,199, against $3,299,218. No zinc was produced in 1921. The ore sold or treated in the district in 1921 averaged $28.68 a ton, compared with $36 in 1920.

Mine production in Tintic district, Utah, in 1921, by kinds of ore.

Kind of ore.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.
		Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Dry or siliceous	25	232,228	12,956.28	4,213,462	936,454	5,511,119
Copper	4	2,653	630.22	49,693	274,412	25,714
Lead	18	106,866	5,172.05	3,314,047	359,186	30,778,710
		341,747	18,758.55	7,577,202	1,570,052	36,315,543

Additional mining ground was purchased by the Chief Consolidated Co.[3] in 1921 in the eastern and southern parts of the Tintic district. A controlling interest was acquired in the Apex Standard Mining Co., Eureka Lily Mining Co., and the East Tintic Consolidated Mining Co. No work was done on the properties of the two last-named companies, but on the Apex Standard the shaft, 900 feet deep, was under development at that level. The Water Lily shaft, in the northeastern section of the district, was completed to a depth of 1,468 feet, a point slightly below the permanent water level, and

[3] Chief Consolidated Mining Co. Thirteenth Ann. Rept., for year ending Dec. 31, 1921.

drifting work commenced. The Grand Central mine, in the southern part of the district, was taken over in December and some necessary improvements made.

The Chief Consolidated Co. continued to lead in output of silver and was the second largest producer of lead in the State. The output of ore was larger than at any time in its history. The annual report of the company shows 93,267 dry tons of ore mined, which yielded $2,167,065.58 after paying smelting, transportation, and sampling charges. Of this amount, a net profit of $336,998.27 was left after deducting other charges. Dividends amounted to $176,805, which makes the total paid to stockholders since February, 1913, $2,048,323.07.

Ore and metals produced by Chief Consolidated mine in 1920 and 1921.

Year.	Ore.	Gold.	Silver.	Lead.	Copper.	Zinc.
	Dry tons.	*Ounces.*	*Ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
1920	82,430	4,461	2,622,132	12,717,410	3,814	212,906
1921	93,267	4,353	3,262,241	12,496,433	11,563	.....
1909–1921[a]	629,244	58,881	18,254,149	88,037,263	397,760	2,401,279

[a] The production of the Chief Consolidated mine by years is given in Mineral Resources, 1918, pt. 1, p. 388.

Of the ore shipped, 37,946 tons was silver-lead ore and 55,321 tons dry or siliceous ore. The average of the total ore output was 0.0467 ounce of gold and 34.977 ounces of silver, 16.47 per cent of lead (in lead ore) and 1.32 per cent of copper (in copper ore). The average total value of all the ores was $41.89 a ton. Smelting, freight, and sampling cost $18.65, leaving a net average value of $23.24. Half the siliceous ore mined was treated in a custom mill at Silver City. Ore was produced and development work performed in the first ore zone on the 800, 1,200, 1,400, 1,600, 1,800, and 1,900 levels, and in the second ore zone on all the levels from the 1,500 to the 2,020 level, where sinking is being carried on in ore.

The Centennial-Eureka mine, according to the company report,[4] produced 5,604 tons of gold and silver ore, and its neighbor, the Bullion Beck & Champion mine, 3,157 tons of ore. Both of these old producers are given over to lessees except for the small amount of prospecting on company account in areas hitherto unexplored.

Ore shipments from the Eagle & Blue Bell mine[5] decreased to 26,554 dry tons in 1921, compared with 29,640 dry tons in 1920. Of the 1921 output, 8,404 tons was mixed carbonate and sulphide lead ore and 18,150 tons was dry or siliceous ore. The lead ore contained 885.19 ounces of gold, 220,975 ounces of silver, 1,985,934 pounds of lead, and 2,235 pounds of copper. The dry ore contained 2,768.56 ounces of gold and 297,558 ounces of silver. After charges for these two classes of ore for freight, smelting, and sampling were deducted, the net smelter returns amounted to $303,135. The distribution of dividends amounted to $44,657.30 in 1921, making the total paid to date $1,607,662.80. A new ore body was opened by a raise from the 1,550 level. From the 2,000 level, 270 feet east of No. 1 shaft, a winze was sunk 52 feet to the new water level. The winze, started

[4] United States Smelting, Refining & Mining Co. Sixteenth Ann. Rept., for year ending Dec. 31, 1921.
[5] Eagle & Blue Bell Mining Co. Ann. Rept. for year ending Dec. 31, 1921.

in low-grade quartz, showed no improvement at depth. A report by engineers appraising the Eagle & Blue Bell and Victoria mines follows in part:

The 15 lode claims are all in one group and comprise an area of 73,148 acres. Centrally located in the productive part of the district, they contain portions of two ore-producing zones and have great value for mining purposes.

* * * The ore bodies occur in two well-defined north and south trending zones. The zone on the west is known as the Eagle and that on the east as the Victoria.

It is not probable that any additional ore zones will be discovered, since that portion of the property lying west of the Eagle zone from the surface to the water level is composed almost entirely of lime shale, a formation generally recognized as nonore-bearing. The depth to which profitable mining operations are likely to extend is taken at 200 feet below normal water level.

In making estimates of ore reserves each zone was considered separately. Geological features bearing upon the factors controlling the localization of the ore bodies in each zone were given close attention. * * *

The method of appraisal of the ore reserves of the Eagle zone likewise were applied to the Victoria zone.

Combined estimates on the two zones show a total ore reserve of 449,084 dry tons, classified as follows:

Zone.	Tons lead ore.	Tons dry ore.	Total tons.
Eagle	208,231	78,876	287,107
Victoria	99,133	62,844	161,977
Total, all classes from all parts of the mine			449,084

With an average annual production of 30,000 tons and a total ore reserve of 449,084 tons, the remaining life of the mine should be approximately 15 years. * * *

The average assay of all "dry" ore produced by the Eagle zone shows 0.144 ounce of gold and 15.50 ounces of silver. The average assay of all lead ore produced by the Eagle zone shows 0.062 ounce of gold and 16.31 ounces of silver per ton and 13.28 per cent of lead.

The Victoria zone is divided east and west into a north and south segment by the Granite claim owned by another company. The southern portion of this zone has produced both lead and "dry" ore at the ratio of 4 tons of "dry" to 3 tons of lead ore, while the northern portion has produced lead ore only. As there is a marked difference in the formations of the two portions of the zone, due to intervening faulting, it is concluded that this difference in the character of their past product is likely to persist in their future product. The average assay of all "dry" ore produced in the past by the Victoria zone showed 0.218 ounce of gold and 13.23 ounces of silver. The average assay of all ore produced by the Victoria zone showed 0.135 ounce of gold and 16.34 ounces of silver a ton, and 14.84 per cent of lead.

In computing the expected gross value of the ore to the mine, metal prices are taken as follows:

Gold at $19.00 per ounce. * * *

Silver at 94.74375 cents per ounce, the expected net value after smelter deductions to the mine under the present price of silver as fixed by the Pittman Act. * * *

Lead: The probable average net value of a pound of lead * * * was determined by taking the average of the daily market quotations in New York over a period of the last 72 years. This equals 5.15 cents per pound, and making deductions * * * for refining and marketing, and * * * slag losses, gave 3.06 cents, the price adopted for purposes of this valuation.

Improved conditions in the Victoria mine[6] resulted in a larger output of ore, which increased from 12,068 dry tons in 1920 to 26,562 tons in 1921. More than two-thirds of the output (18,832 tons) was lead-silver ore, containing 789.19 ounces of gold, 393,050 ounces of silver, and 5,464,571 pounds of lead; and 7,730 tons was siliceous ore, containing 1,171.44 ounces of gold and 89,490 ounces of silver.

[6] Bingham Mines Co. Thirteenth Ann. Rept., for year ending Dec. 31, 1921.

Smelter returns on both grades of ore amounted to $308,620. A new ore shoot was developed early in 1921 on the 1,450 sublevel making along an easterly cross fissure that connects with the Eagle & Blue Bell lode. The workings on the sublevel are all in ore. Considerable low-grade quartz remains in the 1,450 level which can not be profitably mined under conditions existing at the end of 1921. On the 1,700 level, directly beneath the 1,450 ore deposit, exceptionally high-grade ore was found, but so far it has proved to be small and in streaks. At 1,875 feet the level is driven southeastward and should reach its first objective in 350 feet.

An attempt was made, beginning in July, 1919, to find ore in the May Day mine by working at a lower horizon through the shaft of the Yankee mine at a depth of 1,800 feet. A drift was extended 1,600 feet, crosscutting through the May Day territory up to the Godiva property line. Work was discontinued in March, 1921, after a very expensive campaign, the company having drifted in the coarse mottled dolomite of the Chief Consolidated mine. A vein of quartz, containing iron and manganese and a few stains of copper, was followed. This quartz assayed regularly 1 to 3 ounces of silver.

Ore sales from the Iron Blossom mine amounted to $219, 254.75 in 1921, compared with $359,641.85 in 1920. All the property was opened to lessees. One car of 43 tons netted a lessee more than $32,000. Development work by the company was confined to the 600-foot level and east on the 400-foot level of the No. 1 shaft. Dividends paid by the company amounted to $25, 000.

Ore sales from the Colorado property amounted to $23,153.47 in 1921, resulting from shipments taken from the old workings by lessees. Development work by the company was done on a vein 125 feet west of the old ore channel paralleling the old stopes. The work, which is in new territory, was reported encouraging.

The Dragon mine was not operated by the company in 1921, but sales of quartz ore to the Tintic Milling Co., which leased this portion of the mine, amounted to $11,396.46. This ore averaged 60 cents in gold and 4 ounces of silver to the ton and 0.7 per cent of copper. About 75 tons of 52 per cent fluxing iron ore was shipped daily until December by the United States Smelting, Refining & Mining Co., which had a lease on the iron deposit. The sales of iron ore for 1921 amounted to $15,014.64. Surrounding the iron deposit are considerable bodies of a variety of talc which has some of the characteristics of fuller's earth. A sublease on the talc deposit was also given by the company to persons who plan shipments to oil refineries.

The Tintic Standard mine, at Dividend, continued second in the output of silver and third in the output of lead in the district and in the State. According to the annual statement of the company, 123,265 tons of ore, valued at $2,471,913.60, was mined and treated in 1921 Transportation and treatment cost $1,060,888.83, production $884,478.55, and taxes $316,411.89. Dividends paid to stockholders amounted to $176,205. The smelting ore, amounting to 74,552 dry tons, averaged 0.0294 ounce of gold and 25.37 ounces of silver per ton, 0.51 per cent of copper, and 5.31 per cent of lead. The milling ore (48,713 dry tons) contained an average of 0.024 ounce of gold and 13.96 ounces of silver, 0.31 per cent of copper, and 3.53 per cent of lead. The new mill using the chloridizing-roasting process was started in January and operated continuously

making a recovery of 82 per cent of the silver and 70.2 per cent of the copper. No effort was made to recover the lead. A precipitate containing the gold, silver, and copper was shipped to smelters at Omaha, Nebr., and San Francisco, and silver bullion went to the Denver Mint.

Considerable fluxing iron ore was shipped to the smelters from the the Iron King mine, which was under development at its 1,685-foot level. The iron ore is produced on levels nearer the surface and prospecting for other metals is done at the lower levels.

Many small shipments of low-grade silver ore, both siliceous and sulphide, were mined from properties in the vicinity of Silver City and treated by the chloridizing-roasting and leaching process used by the Tintic Milling Co. Silver bullion was shipped from this company's refinery directly to the mint, and copper bullion, which carried about 3 per cent bismuth, was shipped to the copper works at Tacoma, Wash. Some of the ores carry a small quantity of lead and efforts are being made toward saving the lead electrolytically. Shipments of ore were made to the Silver City mill in 1921 from the Empire, Iron Blossom, Mammoth, Martha Washington, Eureka Bullion, Eureka Hill, Eagle & Blue Bell, Tintic Drain Tunnel, Star, Gemini, Joe Bowers, Little May, Primrose, Sunbeam, Swansea, Alaska, and Golden Treasure mines. Other producers of ore which was shipped to smelters were the Eureka Mines, Eureka Hill, Gemini, Gold Chain, Grand Central, Iron Blossom, Mammoth, Ridge & Valley, Showers, Silver Park, and Dragon. The Dragon property produced 20,019 tons of iron flux in addition to other ores shipped to the smelter. The tailing dump of the old concentration mill of the Eureka Hill Mining Co., recently estimated to contain 180,000 tons, is said to assay 1.3 per cent of lead, 0.2 per cent of copper, 5 to 7 ounces of silver, and $1 in gold to the ton.

MORGAN COUNTY.

At the mines in Morgan County development was reported, but no ore shipments were made in 1921.

PIUTE COUNTY.

Mount Baldy district.—Considerable ore was treated in the 100-ton cyanide and concentration plant of the Deer Trail mine, 7 miles southwest of Marysvale. About 10 per cent of the Deer Trail output is sulphide ore in a siliceous gangue, which occurs between a formation of quartzite and lime. The mill treatment consists of crushing the ore in a 2 per cent cyanide solution and running it over concentrating tables to make a lead product. The tailing from the tables is agitated 48 hours, after which it passes to the filter presses.

Ohio district.—Lead ore containing silver and gold was shipped from the Bully Boy mine, which is under development. The property is opened by an adit 2,200 feet long and an inclined shaft 240 feet deep. The ore produced is largely oxidized. Development work was also done on the Shamrock property, during which a shipment of copper ore, containing considerable gold and silver, was made by lessees. A little work was done at the Wedge mine, but no production of importance was reported.

SALT LAKE COUNTY.

Big and Little Cottonwood districts.—The Cardiff mine, the principal producer in the Big Cottonwood district, yielded lead-silver ore containing copper. Other producers were the Howell, Maxfield, Prince of Wales, Woodlawn, and Alta Tunnel. The Alta Tunnel mine has opened considerable lead-silver ore in ground leased from the Walker Estate. The total output of 6,167 tons of ore reported by six producers in the Big Cottonwood district contained $908 in gold, 141,191 ounces of silver, 121,025 pounds of copper, and 2,513,073 pounds of lead, valued in all at $270,799, or $43.91 a ton.

Ten producers in the Little Cottonwood district reported 8,136 tons of ore shipped to the smelter, containing $4,093 in gold, 169,517 ounces of silver, 175,271 pounds of copper, and 1,946,128 pounds of lead, valued in all at $283,796, or $34.88 a ton. The Columbus-Rexall was the largest producer of lead-silver ore, followed by the South Hecla, Michigan-Utah, Wasatch Mines, Emma Silver, and Sells mines. Other producers were the Alta Consolidated and Cabin properties.

Mine production in Big Cottonwood and Little Cottonwood mining districts, Utah, 1920–21.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	15	18,299	$6,806	413,863	566,003	5,499,436	.....	$1,002,015
1921	16	14,303	5,001	310,708	296,296	4,459,201	.....	554,595
Increase or decrease, 1921	+1	−3,996	−1,805	−103,155	−269,707	−1,040,235	.....	−447,420
Total, 1867–1921	.....	519,132	532,349	14,668,478	13,350,234	201,439,886	322,055	29,419,587

On account of the heavy snowfall during the winter hauling of ore did not begin until about June 1. The operators of the Cardiff mine, on the Big Cottonwood side, hauled ore to storage bins at the mouth of South Fork Canyon during the winter. Autotrucks began hauling from the ore bins to the smelter on June 1. A new discovery of ore was reported on the 1,100-foot level of the Cardiff mine.

In October the Alta Tunnel shipped its first car of carbonate lead ore from its new development in Prince of Wales territory. This shipment assayed 44.7 ounces of silver to the ton and 23.3 per cent of lead and netted the company $57.15 a ton.

From Little Cottonwood Canyon ore began to move from Alta about June 1. It was hauled by sled and wagon 7 miles to the broad-gage railroad terminal at Wasatch. The first ore tram over the narrow-gage system arrived June 21. Hauling by rail to Wasatch was suspended September 24.

On October 19 the South Hecla Mines Co., a new corporation, combined the mines of the South Hecla, Albion, Alta-Utah, and South Hecla Extension.

Considerable silver ore was opened in the Emma Silver mine on the west side of the Montezuma fault above water level, in virgin ground. Heretofore only the east side of the fault has been productive.

Smelter district.—Considerable material left by the former lessees of the old tailing dump below the Midvale smelter was treated by differential flotation. Concentrate containing lead, silver, and a little copper was shipped. Old slag sorted from smelter dumps and ore from car and track cleanings near the samplers added to the State output.

The annual report[7] of the company operating the Midvale smelter and concentration mills gives the following information:

The concentrator at the Midvale smelter milled 138,771 tons of crude ore of average grade in comparison with 106,874 tons for the preceding year. The lead smelter treated 187,192 tons of marginal ore as against 215,757 tons in 1920, the reduced tonnage being accounted for wholly by reason of curtailment of custom ore shipments due to the low price of lead in comparison with production cost. Of company ores and concentrates the smelter reduced an increased tonnage as indicated by the above concentrator figures. Lead bullion output for the year was 27,610 tons, being a reduction of 4,130 tons. By-products, including arsenic and arsenical compounds, were recovered or manufactured into marketable forms, and while this figure of the business is to a large extent dependent upon agricultural developments or conditions, it is nevertheless a growing business that provides an avenue for the consumption of one of the by-products of ores.

Bingham or West Mountain district.—The average value of the ore produced in the Bingham district in 1921 was $4.32 a ton, against $4.54 in 1920; the shipments of ore to the smelters amounted to 71,118 tons, against 188,454 tons; the output of concentrating ore was 1,367,490 tons, against 5,728,723 tons; and the quantity of concentrates produced was 114,950 tons, against 375,204 tons. Ore of smelting grade amounting to 71,118 tons consisted of low-grade copper and lead sulphides and contained 11,346.33 ounces of gold, 366,259 ounces of silver, 2,843,390 pounds of copper, and 4,171,734 pounds of lead, valued in all at $1,155,333, or $16.25 a ton. Milling ores, of which there were 1,367,490 short tons, produced 114,950 tons of copper, lead, and zinc concentrates that contained 34,827.99 ounces of gold, 607,725 ounces of silver, 24,546,132 pounds of copper, 20,404,912 pounds of lead, and 69,390 pounds of recoverable zinc, valued in all at $5,416,022, or $47.12 a ton.

Mine production in Bingham or West Mountain district, Utah, 1920–21.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	31	6,067,180	$1,054,915	1,589,972	110,670,055	52,488,597	2,113,741	$27,521,576
1921	23	1,538,309	954,525	973,984	28,611,004	24,576,646	69,390	6,651,346
Decrease, 1921	8	4,528,871	100,390	615,988	82,659,051	27,911,951	2,044,351	20,870,230
Total, 1865–1921	.....	.....	36,773,484	55,024,670	2,125,209,314	1,269,541,918	50,541,375	544,694,778

[a] Includes small placer production.

Total dividends, 1865–1921, $126,380,588.

[7] United States Smelting, Refining & Mining Co. Sixteenth Ann. Rept., for year ending Dec. 31, 1921.

Ore and metals produced in Bingham district, Utah, in 1921.

Source of production.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.
		Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Placers	1	.....	0.92	.....	.....	.....	.....
Dry or siliceous ore	4	25,693	1,681.14	100,895	251,209	255,540	.....
Copper ore	9	1,354,649	13,509.66	162,966	26,981,788	193,942	.....
Lead ore	16	157,967	30,983.42	710,123	778,007	24,127,164	69,390
	.....	1,538,309	46,175.14	973,984	28,011,004	24,576,646	69,390

The Utah Copper Co.[8] produced 1,220,700 tons of concentrating copper ore, compared with 5,556,800 tons in 1920. From the 1,220,700 tons of ore mined by steam shovels 55,666 dry tons of concentrate was recovered averaging 21.32 per cent of copper. The Magna concentrator was idle in 1921. No carbonate ore was mined or shipped to the leaching works at Magna, but treatment of 43,551 tons in process of leaching at the beginning of 1921 was completed, and the copper recovered from leach solution, totaling 590,642 pounds, was shipped to the smelter. The Arthur concentrator was operated continuously up to and including April 4, when work was discontinued. The average grade of the ore milled was 1.16 per cent of copper, the same as for 1920. The average recovery was 83.87 per cent, corresponding to 19.44 pounds of copper to the ton of ore treated. The average milling cost was $1.17 a ton, and the cost of mining the concentrating ore, including the proper apportionment of fixed and general charges, Federal taxes and depreciation excepted, was 49.98 cents a ton, 26.76 cents a ton representing all charges at the mine and 10.72 cents all fixed and general charges. The yield of copper from 55,666 tons of concentrates was 23,730,798 pounds. Additional shipments of concentrates, amounting to 2,359 tons, containing 1,099,789 pounds of copper, were made from cleaning up the mills.

The average cost per pound of net copper (from concentrate only) was 12.88 cents, and the average cost of total net production was 12.72 cents, exclusive of charges for depreciation of plant and equipment. This cost includes all general charges, and if the net value of the gold and silver recovered, equivalent to 1.15 cents a pound, is credited, the net cost for the copper output in 1921 becomes 11.57 cents a pound.

In 1921 the Utah Copper Co. sold 24,511,593 pounds of copper at 12.929 cents a pound, 7,040.763 ounces of gold at $20 an ounce, and 65,928.75 ounces of silver at 99.946 cents an ounce, valued in all at $3,375,567.73. Dividends from capital distributions amounted to $4,061,225 in 1921, which makes the total disbursements made to stockholders $115,570,887.50.

The report[9] of the United States Smelting, Refining & Mining Co. contains the following paragraph regarding property in Utah:

> The Bingham * * * mines * * * , including the Niagara Mining Co., produced and shipped during the year an aggregate of 151,450 wet tons of complex

[8] Utah Copper Co. Seventeenth Ann. Rept., for year ending Dec. 31, 1921.
[9] United States Smelting, Refining & Mining Co. Sixteenth Ann. Rept., for year ending Dec. 31, 1921.

gold, silver, lead-zinc ore, which compares with 102,842 wet tons in the previous year. In addition thereto, the property yielded and marketed 9,547 wet tons of copper ore of excellent grade in respect to its gold as well as its copper content. Operations were conducted without interruption during the year. Development at lower levels of the mines has proved productive both in tonnage and in average values of the complex ore, and a large part of the copper ore output resulted from this new work.

During 1921 the Bingham Mines Co. developed considerable sulphide iron ore below the level of the Mascotte tunnel in the Dalton & Lark mines. The value of the gold, silver, and copper in the ore was not sufficient to afford profitable mining, but the excess of iron over silica made the ore desirable as a flux. The mining of such ore permitted a continuation of operations throughout the year. The copper output came principally from the Brooklyn vein. A small lot of lead ore was obtained from the Lark vein in the Sampson workings and from No. 4 west on the Mascotte tunnel level. Lessees mined 3,591 dry tons of ore from which the company received a royalty of $9,849.67. The company's output in 1921,[10] exclusive of ore mined by lessees, was as follows:

Mine production by Dalton and Lark mines, Bingham district, Utah, 1921.

Kind of ore.	Ore.	Gold.	Silver.	Lead.	Copper.	Gross value.	Smelter returns.
	Dry tons.	*Ounces.*	*Ounces.*	*Pounds.*	*Pounds.*		
Lead ore	439.43	41.57	4,231.04	157,136	11,012	$10,020.09	$6,319.45
Copper ore	23,634.50	1,613.68	65,256.71	.....	234,405	97,884.59	78,715.20
	24,073.93	1,655.25	69,487.75	157,136	245,417	107,904.68	85,034.65
Company and lease ore produced, 1909–1921	.....	33,050	2,743,511	40,626,310	12,430,433	.....	.....

From the Yosemite mine[11] 281 dry tons of lead-silver ore was shipped, containing 11.10 ounces of gold, 2,014 ounces of silver, 76,068 pounds of lead, and 949 pounds of copper.

The Mayflower vein of the Fortuna mine of the Montana-Bingham Consolidated Mining Co.[12] was worked and produced 23,146 dry tons of copper-iron sulphide ore of shipping grade, against 4,433 tons in 1920. The output in 1921 was the largest in the history of the Fortuna mine. Advantage was taken of favorable smelting rates on lower-grade ores and the cheaper loading facilities made possible by the Montana-Bingham tunnel with its new ore bins at the portal on the railroad. All the ore shipped in 1921 was copper ore except one lot of 68 tons of lead ore. The average assay of the copper ore was 0.059 ounce of gold and 1.84 ounces of silver per ton and 3.43 per cent of copper. The lead ore assayed 0.045 ounce of gold and 6.20 ounces of silver per ton, 0.7 per cent of copper, and 15.8 per cent of lead. The total value of the company ore was $192,027.58, and the smelter returns $140,188.82. Lessees shipped from the old Fortuna workings 457 wet tons of copper ore and 20 tons of lead ore.

Mining operations at the Highland Boy mine[13] were greatly curtailed during the first quarter of 1921. Only ore mined in the

[10] Bingham Mines Co. Thirteenth Ann. Rept., for year ending Dec. 31, 1921.
[11] Idem.
[12] Montana-Bingham Consolidated Mining Co. Ann. Rept. for year ending Dec. 31, 1921.
[13] Utah Consolidated Mining Co. Ann. Rept. for year ending Dec. 31, 1921.

course of exploration and development work was shipped during the year. This amounted to 1,183 dry tons of copper-iron sulphide ore and 975 dry tons of lead ore. After April 1 a further curtailment was made, which lasted the remainder of the year. Construction of the new mill designed to use pneumatic flotation was practically completed in December. The plant will treat 1,000 tons of copper ore a day, making about 150 tons of concentrate, and is at International, about 5 miles from the mine, with which it is connected by aerial tramway. Ore reserves consist of 837,000 tons of copper ore, averaging 1.97 per cent of copper, 0.57 ounce of silver, and 0.04 ounce of gold per ton.

The mine and mill of the Utah Apex Mining Co. were idle in 1921. Only a sufficient force of men was employed for the maintenance of the property and the experimental work being done on a large scale in the flotation department of the mill.

The gross sales of ore from the property of the Utah Metal & Tunnel Co. amounted to $37,142.50 for 1,495 tons of ore taken out by lessees, who received $23,146.65 from the smelter. The average metal content was 0.0576 ounce of gold and 11.16 ounces of silver to the ton, 2.47 per cent of copper, and 19.60 per cent of lead.

Other producers shipping lead ore were the New England, Bingham Coalition, Silver Shield, New York-Bingham, Ute Copper, and General Grant mines. Those shipping copper ore were the Tesora and United Bingham mines. Some siliceous silver ore was shipped from the Queen, Lucky Boy, and Barstow claims.

SAN JUAN COUNTY.

No reports of production or development of mining property were received in 1921 from San Juan County. The lease on the mine and mill of the Big Indian Copper Co. in the La Sal district has been given up by the Buena Vista Copper Co. Experiments at the mill during the last two years were not successful in producing a commercial product.

SUMMIT AND WASATCH COUNTIES.

The Uinta district, in Summit County, and the Blue Ledge and Snake Creek districts, in Wasatch County, represent the producing area of the Park City region in 1921.

Mine production in Park City mining region, Utah, 1920–21.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	14	173,869	$83,900	2,672,389	1,156,772	25,732,104	3,442,445	$5,547,056
1921	13	130,608	74,002	2,187,236	805,525	17,691,222	.....	3,161,256
Decrease, 1921	1	43,261	9,898	485,153	351,247	8,040,882	3,442,445	2,385,800
Total, 1870–1921	.....	.....	4,677,043	144,677,691	34,667,360	1,341,499,548	74,344,120	187,055,567

Total dividends, 1870–1921, $45,144,530.

The Silver King Coalition mine[14] produced 26,070.6 dry tons of shipping ore, of which 9,671.7 tons was mixed lead carbonate and sulphide ore and 12,017.9 tons was low-grade iron ore. Milling ore amounting to 4,381 tons was treated in the mill, which was destroyed by fire January 27, 1921. Concentrates and middlings from the ore milled amounted to 623.2 tons of the former and 1,540.6 tons of the latter. Lessees shipped 759.59 tons of ore.

Gold, silver, copper, and lead produced by Silver King Coalition mine, Utah, 1921.

Kind of material.	Gold (ounces).		Silver (ounces).		Lead.		Copper.		Net smelter returns.
	Per ton.	Total.	Per ton.	Total.	Percentage.	Pounds.	Percentage.	Pounds.	
First-class ore	0.068	657.90	35.07	329,198	23.24	4,496,949	0.72	140,808	$377,681
Concentrates	.045	28.40	26.00	16,201	27.09	337,732	.04	5,413	21,993
Middlings	.054	83.24	6.93	10,683	4.69	144,547	.16	4,995	1,703
Crude iron ore	.042	512.60	7.46	89,695	3.78	908,748	.37	89,589	96,221
Lessees' ore	.110	83.73	32.16	24,367	24.67	375,232	.47	7,150	8,435
		1,365.87		470,144		6,263,208		247,955	506,033

Mining of the ore in the Silver King Coalition property, including haulage and hoisting, cost $6.99 a ton. Development cost, the same items included, amounted to $16.52 a foot; diamond drilling, $3.41 a foot; and milling, $2.15 a ton.

During 1921 the Spiro adit of the Silver King Consolidated property[15] was driven 904 feet, making its total length 15,014 feet. Ore sales amounted to $1,179.50 for 29 dry tons of ore, which contained 2.67 ounces of gold, 1,221 ounces of silver, 2,326 pounds of copper, and 3,082 pounds of lead. The adit opened up a number of small veins of rich mineral, which will probably be followed in future work.

In the Blue Ledge district, east of Park City, a large body of siliceous silver ore was developed in the Park-Utah property during 1921, thus adding a new producer to the list of Park City shippers.

The Park-Utah Co. was incorporated in 1917, but development was not begun until 1919 owing to war conditions. This new ore deposit was opened north of and along the McHenry fault, which is traceable from the south head of McHenry Canyon eastward along the north side of the canyon to a point about 2,000 feet east of the Liberty tunnel, a total distance of 1 mile. Attention was callled to the importance of ore possibilities in this northeastern section in connection with the Frog Valley overthrust fault, in a paper[16] published by the Geological Survey in 1912.

Work was started on a crosscut from a point 8,700 feet from the portal of the old Ontario drain tunnel. Several shoots of high-grade ore were intersected by the crosscut, which was driven 1,650 feet and is called the 1,500-foot level. One of the ore shoots was followed on the strike of the deposit for a distance of 300 feet. Crosscuts run at intervals of 60 feet are said to prove a shoot of shipping-grade ore 5 to 27 feet in width. In December the company was shipping at the rate of 2,000 tons of ore monthly, all of it from development work.

[14] Silver King Coalition Mines Co. Ann. Rept. for year ending Dec. 31, 1921.
[15] Silver King Consolidated Mining Co. Ann. Rept. for year ending Dec. 31, 1921.
[16] Boutwell, J. M., Geology and ore deposits in the Park City district, Utah: U. S. Geol. Survey Prof. Paper 77, p. 96, 1912.

The ore, which is essentially a silver ore, carries some gold, with a little lead, copper, and zinc. These metals are contained in tetrahedrite, galena, and sphalerite in a siliceous gangue, carrying an average of 8 per cent of pyrite and 2 per cent of galena. The net smelter returns averaged nearly $50 a ton. An initial dividend of 5 cents a share, or $50,000, was distributed to stockholders on December 15.

Ore was produced by the New Quincy, Revelator, Southern Tier, Glen Allen, and Judge properties in the Snake Creek district. Concentrate was shipped from the Glen Allen and Judge concentration mills, but the Judge electrolytic zinc plant was not operated. No annual printed reports were issued by the Judge allied companies, which include the Judge, Daly West, Daly, and Park-Utah mines.

In the Uinta district the Daly West, Naildriver, Ontario, American Flag, and Daly mines were producers of considerable ore, and concentrate was produced from old tailing treated in the Moore plants.

TOOELE COUNTY.

Mine production in Tooele County, Utah, 1920–21.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	27	105,826	$10,178	498,393	1,203,677	10,272,259	807,849	$1,662,120
1921	19	17,487	8,272	82,251	97,354	2,538,512	.....	217,315
Decrease, 1921...	8	88,339	1,906	416,142	1,106,323	7,733,747	807,849	1,444,805

Blue Bell district.—The R. E. P. No. 1 property was the only producer in the Blue Bell district, and its output was lead ore containing silver.

Clifton district. (Gold Hill)—Four producers in the Clifton district reported the output of 11,627 tons of ore, containing gold, silver, copper, and lead, valued at $44,253, or $3.81 a ton. Most of the ore of the Western Utah Copper Co., at Gold Hill, was sold at a flat rate, mainly for its arsenic content, although it contained small quantities of gold, silver, copper, and lead. A large reserve of about 750,000 tons of arsenical ore (largely the mineral scorodite), averaging 12 per cent of arsenic, is said to be developed in the mine. Other producing properties were the Rube and Silver King.

Ophir district.—The output of ore in the Ophir district, amounting to 4,061 tons, was mined by five operators and contained $1,438 in gold, 40,194 ounces of silver, 90,895 pounds of copper, and 960,050 pounds of lead, valued in all at $96,560, or $23.78 a ton. Of this output, the shipping ore amounted to 1,571 tons and the concentrating ore to 2,490 tons, yielding 830 tons of lead concentrate. The producers were the Ophir Hill, Hidden Treasure, Buffalo Consolidated, Argent, and Magnolia mines.

Rush Valley district (Stockton).—The Bullion Coalition Mines Co., operating the Honerine property, was the principal producer of lead-silver ore shipped to the smelter by lessees in the Rush Valley district. Considerable lead-silver ore was shipped from the Galena King mine, also under lease.

Silver Islet district.—The Silver Tip, Lodato, Gethin Leroy, and Silver Island Metals properties contributed small lots of ore to the output of the Silver Islet district, which amounted to 20 tons of silver-lead ore, valued at $894, or $44.70 a ton.

Wild Cat Range district.—The Silver Queen group, leased by the Fluorite Mines Co., 20 miles south of Clive on the Western Pacific Railroad, produced one lot of silver-copper ore and 315 tons of fluorite, which was not shipped.

UINTAH COUNTY.

Sluicing operations in the vicinity of Horshoe Bend, on Green River, near Vernal post office, resulted in the output of a little placer gold. Most of the gold recovered is 900 fine.

UTAH COUNTY.

American Fork district.—Three mine operators in the American Fork district reported 179 tons of ore of shipping grade, containing principally gold with a little lead and copper, and 76 tons of concentrating ore, which produced 19 tons of lead concentrate containing silver and copper. The total output was valued at $9,043, or $35.46 a ton. The producers were the American Fork Leasing Co., operating the Silver Wave and Live Yankee properties, and some lead ore was picked up from around the old Sultana smelter site. The Dutchman mine was also the producer of a small quantity of lead-silver ore. The Pacific mine was not a producer in 1921, but according to the company's annual report continued to develop sulphide milling ore containing gold, silver, and copper, which may be amenable to treatment in the mill at the mine.

Mine production in American Fork district, Utah, 1920–21.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	3	49	$11	296	179	18,619	.....	$1,856
1921	3	255	4,101	1,813	15,314	25,618	.....	9,043
Increase, 1921	.....	206	4,090	1,517	15,135	6,999	.....	7,187
Total, 1870–1921	.....	76,512	277,380	1,926,153	193,184	30,098,740	46,911	4,052,235

Tintic district.—The most important producers on the Utah County side of the Tintic district were the Tintic Standard, Colorado Consolidated, and Iron King properties. These properties are all mentioned in the section devoted to the Tintic district under Juab County.

WASHINGTON COUNTY.

Harrisburg district.—All the work on ore in the Harrisburg district has been of an experimental nature. A little silver bullion was produced, principally by cyanidation. All the old mines in the district, with fully 60,000 feet of development work of all kinds, have been organized under the name Silver Reef Consolidated Mines Co. Operations at these properties were discontinued May 1, 1921, awaiting plans for a mill.

GOLD, SILVER, AND LEAD IN SOUTH DAKOTA.

(MINES REPORT.)

By Charles W. Henderson.

PRODUCTION.

Of the nine producing mines in South Dakota in 1921 three were deep (only two of importance) and six were small placers—an increase of two placers from 1920 but the same number of deep mines. The mills of the State treated 1,725,528 tons of ore, which yielded as bullion $6,601,836 in gold and 111,415 fine ounces of silver, valued at $111,415, an average recovery per ton of $3.826 in gold and 0.065 ounce in silver, as compared with $3.45 in gold and 0.064 ounce in silver in 1920.

Mine production of gold, silver, and lead in South Dakota in 1920 and 1921.

Year.	Number of producing mines.	Ore (short tons).	Gold.[a]		Silver.[a]	
			Fine ounces.	Value.	Fine ounces.	Value.
1920	7	1,356,189	226,224.23	$4,676,470	90,795	$98,966
1921	9	1,725,685	319,524.95	6,605,167	112,464	112,464
Increase, 1921	2	369,496	93,300.72	1,928,697	21,669	13,498

Year.	Lead.		Total value.
	Pounds.	Value.	
1920	12,812	$1,025	$4,776,461
1921	4,000	180	6,717,811
Increase or decrease, 1921	— 8,812	— 845	+1,941,350

[a] Includes placer production.

Gold and silver bullion produced at mills in South Dakota in 1921.

Process.	Ore treated.	Gold in bullion.	Silver in bullion.	Quicksilver used.	Sodium cyanide used.	Cyanamid used.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Amalgamation	1,620,588	214,003.69	60,604	22,500	.....	.....
Cyanidation	[a] 1,669,635	105,360.12	50,811	.....	673,050	87,744
	.....	319,363.81	111,415	22,500	[b] 673,050	87,744

[a] Includes 1,620,588 tons of sands and slimes from the ore amalgamated and 49,047 tons of ore cyanided.
[b] Includes 117,406 pounds of cyanide of 98 per cent NaCn, 467,900 pounds of cyanide of 48 per cent NaCn, and 87,744 pounds of cyanamid.

Mine production of gold and silver in South Dakota, 1876–1921.[a]

Period.	Gold.	Silver.		Total value (commercial).
		Fine ounces.	Commercial value.	
1876–1880	$11,255,843	80,292	$92,452	$11,348,295
1881–1890	30,800,000	1,472,580	1,515,224	32,315,224
1891–1900	48,005,555	1,729,873	1,155,691	49,161,246
1901–1910	65,242,196	1,790,365	1,013,349	66,255,545
1911	7,439,874	203,755	107,990	7,547,864
1912	7,891,370	206,460	126,973	8,018,343
1913	7,319,294	172,702	104,312	7,423,606
1914	7,333,508	176,642	97,683	7,431,191
1915	7,406,305	199,864	101,331	7,507,636
1916	7,460,644	215,205	141,605	7,602,249
1917	7,364,233	186,765	153,894	7,518,127
1918	6,565,337	159,202	159,202	6,724,539
1919	4,863,040	116,493	130,472	4,993,512
1920	4,676,470	90,795	98,966	4,775,436
1921	6,605,167	112,464	112,464	6,717,631
	230,228,836	6,913,457	5,111,608	235,340,444

[a] For yearly output to 1913 and authority for each year, see U. S. Geol. Survey Mineral Resources, 1913, pt. 1, p. 42, 1914.

Mine production of gold, silver, and lead in South Dakota in 1921, by classes of ore.

Source.	Number of mines.	Ore.	Gold.	Silver.	Lead.
Deep mines:		*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*
Dry gold ore	2	1,725,669	319,435.51	111,620	.....
Lead ore	1	16	.....	837	4,000
	3	1,725,685	319,435.51	112,457	4,000
Placer mines	6	.....	89.44	7	.....
	9	1,725,685	319,524.95	112,464	4,000

MINING INDUSTRY.

Operations at the Homestake mine were at full capacity in 1921, presenting a contrast to those in 1920, when the first four months of the year was occupied in continuing the work of removing the water pumped into the mine in 1919 to extinguish the fire. The Trojan mine and mill were operated continuously. The Trojan Co. during the year acquired nearly all the property of the Ofer Gold Mining Co. (formerly Imperial Co.). Minor operations are noted in the review by counties.

REVIEW BY COUNTIES.

CUSTER COUNTY.

Small sluicing operations in the vicinity of Custer yielded 30 crude ounces of placer gold, averaging 0.951 gold and 0.043 silver.

LAWRENCE COUNTY.[a]

Mine production of gold, silver, copper, and lead in Lawrence County, S. Dak., 1916–1921.

Year.	Number of mines producing.	Ore.	Gold.[b]	Silver.[b]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1916	29	1,870,572	$7,455,136	215,127	.....	35,406	$7,599,127
1917	24	1,868,143	7,360,266	186,436	736	60,905	7,519,328
1918	13	1,781,661	6,564,850	158,108	2,996	11,536	6,724,517
1919	5	1,329,928	4,863,013	116,010	.....	6,585	4,993,293
1920	7	1,356,189	4,676,470	90,795	.....	12,812	4,776,461
1921	3	1,725,685	6,603,318	112,457	.....	4,000	6,715,955
Increase or decrease, 1921	−4	+369,496	+1,926,848	+21,662	.....	−8,812	+1,939,494

[a] For information on the geology of this county, see Irving, J. D., Ore deposits of the northern Black Hills: U. S. Geol. Survey Bull. 225, pp. 123–140, 1904; Irving, J. D., and Emmons, S. F., Economic resources of the northern Black Hills: U. S. Geol. Survey Prof. Paper 26, pp. 53–212, 1904.
[b] Includes both placer and deep mines.

The total value of the product of the Homestake Mining Co. from 1875 to 1921 is $175,733,939.87, and the amount paid in dividends is $42,924,664.29.

Production of Homestake mine, 1916–1921.

Year.	Ore milled.	Value of product.	Value per ton.	Dividends.
	Short tons.			
1916	1,600,220	$6,531,003.34	$4.0813	$2,210,208.00
1917	1,677,623	6,619,573.94	3.9458	1,959,048.00
1918	1,628,630	5,916,890.31	3.6330	1,506,960.00
1919	1,192,588	4,346,115.79	3.6443	1,130,220.00
1920	1,274,944	4,410,193.73	3.4591	.....
1921	1,620,588	6,299,780.38	3.8873	502,320.00

The annual report of the superintendent of the Homestake Mining Co., dated December 31, 1921, says:

Nothing out of the ordinary has occurred during the year just passed to interfere with the normal operation of the mine. The physical condition of the mine and the reduction plants is excellent.

Grading for the site of the South mill was begun in January and completed during the year. All concrete foundations have been placed, and 48 per cent of the structural steel for the superstructure has been erected. The mechanical equipment is either on the ground or at the factory ready for shipment.

Two of the skip loaders and underground crushers for the Ellison electric hoist will be installed during the coming year and the hoist put into operation. This work has been delayed in order that the foundations of the South mill could be finished before cold weather.

A 7-foot by 14-foot air shaft has been excavated from the surface to the 900-foot level as a part of the mine ventilating system.

The mine engineers report as follows: Development drifts driven 7,239 feet; development raises driven 4,681 feet. Ellison shaft sunk 71 feet. There are 1,219,125 tons of ore broken down and remaining in the stopes.

The crushing capacity of the Homestake amalgamation and cyanide mills at the end of 1921 was: Six wet-crushing stamp mills aggregating 1,020 stamps, capacity 4.5 tons per stamp per day; two cyanide sand plants, capacity 75,000 tons monthly; one cyanide slime plant, capacity 60,000 tons monthly; seven tube mills, capacity 15,000 tons monthly; one ball mill, capacity 7,200 tons monthly. During 1921 one ball mill and 920 stamps were operated.

The Trojan mine and 400-ton cyanidation mill were operated continuously during the year. The purchase of the Ofer Co.'s property included the Dakota claim, on which is a 568-foot vertical shaft. The property is now developed by two vertical shafts (the other one 308 feet deep) and six adits aggregating 7,000 feet. A small quantity of custom ore was treated at the mill.

The Golden Reward mill at Deadwood (closed in 1918) was dismantled in 1921, and the machinery was moved to the mine at Terry, where is located the company's roaster plant. The Mogul and New Reliance mills remained idle.

In the Bear Butte district one car of lead-silver ore was shipped from the New Silver Queen mine.

In the Two-Bit district the Gold Feather Co. began in September the construction of a 20-stamp mill on the Monarch property.

No placer gold was recovered in the Rawlings district in 1921.

PENNINGTON COUNTY.

Beginning August 1, sluicing operations on the Hudo claim, 2½ miles above Mystic, on Castle Creek, yielded a considerable quantity of placer gold, averaging 0.892 gold and 0.095 silver. A small quantity of placer gold was produced by sluicing on Rapid Creek.

GOLD, SILVER, AND COPPER IN WYOMING.

(MINES REPORT.)

By CHARLES W. HENDERSON.

PRODUCTION.

One car of copper ore from the Electrolytic (Rambler) mine, near Albany, and one car of copper ore from the Copper Bottom mine, near Frederick, constituted the marketed output of ores mined in Wyoming in 1921.

Mine production of gold, silver, and copper in Wyoming, 1842–1921.[a]

Period.	Ore (short tons).	Gold.	Silver.		Copper.		Total value.
			Fine ounces.	Commercial value.	Pounds.	Value.	
1842–1866		(b)					
1867–1870		$396,100	3,170	$4,098			$400,198
1871–1880		400,000	3,240	4,115			404,115
1881–1890		67,500	2,940	3,126	1,395,287	$230,521	301,147
1891–1900		131,700	1,400	943	7,541,647	1,257,649	1,390,292
1901–1910		130,259	45,983	26,896	16,906,466	2,579,095	2,736,250
1911	3,491	19,200	725	384	130,499	16,312	35,896
1912	2,439	22,235	265	163	25,080	4,138	26,536
1913	4,236	24,184	957	578	385,239	59,712	84,474
1914	423	5,006	116	64	17,421	2,317	7,387
1915	4,216	14,592	840	426	447,246	78,268	93,286
1916	8,876	20,566	5,524	3,635	2,610,622	642,213	666,414
1917	6,335	3,762	3,415	2,814	2,027,857	553,605	560,181
1918	2,870	871	965	965	852,777	210,636	212,472
1919	798	84	151	169	139,900	26,021	26,274
1920							
1921	50	62	111	111	10,000	1,290	1,463
		1,236,121	69,802	48,487	32,490,041	5,661,777	6,946,385

[a] For yearly output, 1842–1914, see U. S. Geol. Survey Mineral Resources, 1914, pt. 1, pp. 248–249, 1916.
[b] Small; unknown.

REVIEW BY COUNTIES.

Albany County.—From the Electrolytic mine (long known as the Rambler) one car of copper ore, carrying also gold, silver, platinum, and palladium, was shipped to Garfield, Utah, the platinum and palladium content being sacrificed on account of the higher freight rate to eastern refineries. Two other cars of similar ore were mined and hauled to the station at Albany, but were held there pending negotiations with other refineries. At the Colowyo property, at Centennial, the development adit was extended from 780 to 817 feet.

Fremont County.—The Carissa mine, at Atlantic City, was kept unwatered.

Goshen County.—Development work in 1920 on the Copper Bottom mine, in the Muskrat Creek district, resulted in a shipment of copper ore in 1921.

Lincoln County.—Prospect work was done on placer claims near Afton.

Platte County.—No copper ore was shipped from the copper veins of the open-cut workings of the Sunrise iron mine of the Colorado Fuel & Iron Co., from which much copper ore had been shipped during 1915–1919. No iron ore was shipped from this mine during the last quarter of 1921, and the price of copper was not conducive to cobbing of copper ore from the broken iron ore.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA.

(MINES REPORT.)

By V. C. Heikes.[1]

PRODUCTION.

SUMMARY.

The output of all metals produced in Nevada in 1921 decreased in quantity and value. Four mining companies paid dividends amounting to $685,076.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	473	3,480,620	$3,566,728	7,745,093	50,559,763	21,263,700	10,698,040	$23,879,512
1921	431	1,096,138	3,312,757	7,083,782	10,961,491	7,188,768	69,397	12,137,536
Decrease, 1921	42	2,384,482	253,971	661,311	39,598,272	14,074,932	10,628,643	11,741,976
Total, 1904-1921	.....	60,596,065	179,579,064	187,933,440	974,037,741	228,727,639	172,484,460	519,071,561

[a] Includes placer production.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1921, by counties.

County.	Gold.					Silver.	
	Placers.		Deep mines.		Total value.	Fine ounces.	Value.
	Fine ounces.	Value.	Fine ounces.	Value.			
Churchill	.....	.....	32.60	$674	$674	3,837	$3,837
Clark	.....	.....	3,602.78	74,476	74,476	12,094	12,094
Douglas	2.32	$48	4.02	83	131	3	3
Elko	94.38	1,951	29,138.87	602,354	604,305	264,439	264,439
Esmeralda	27.76	574	11,028.44	227,978	228,552	445,826	445,826
Eureka	20.03	414	2,439.02	50,419	50,833	45,904	45,904
Humboldt	24.09	498	1,069.81	22,115	22,613	21,476	21,476
Lander	3,470.91	71,750	1,309.36	27,067	98,817	26,473	26,473
Lincoln	.....	.....	426.09	8,808	8,808	264,304	264,304
Lyon	6,434.84	133,020	1,381.35	28,555	161,575	22,054	22,054
Mineral	6.58	136	5,199.64	107,486	107,622	47,561	47,561
Nye	7,472.15	154,463	57,358.96	1,185,715	1,340,178	4,699,710	4,699,710
Ormsby	.....	.....	.05	1	1	182	182
Pershing	4.21	87	9,384.17	193,988	194,075	739,975	739,975
Storey	.....	.....	15,713.51	324,827	324,827	263,931	263,931
Washoe	.....	.....	224.36	4,638	4,638	171,443	171,443
White Pine	9.72	201	4,374.60	90,431	90,632	54,570	54,570
	17,566.99	363,142	142,687.63	2,949,615	3,312,757	7,083,782	7,083,782

[1] Valuable assistance in the preparation of the report and the compilation of the statistical tables has been rendered by B. N. Patchell, of the U. S. Geological Survey.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1921, by counties—Continued.

County.	Copper.		Lead.		Recoverable zinc.		Total value.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
Churchill	194	$25	38,393	$1,728	.....	.....	$6,264
Clark	31,247	4,031	284,217	12,790	69,397	$3,470	106,861
Douglas	.....	.....	.....	.....	.....	.....	134
Elko	10,147	1,309	1,525,192	68,684	.....	.....	938,687
Esmeralda	4,244	547	61,024	2,746	.....	.....	677,671
Eureka	206,948	26,696	776,943	34,962	.....	.....	158,395
Humboldt	457	59	3,245	146	.....	.....	44,294
Lander	28,401	3,664	70,844	3,188	.....	.....	132,142
Lincoln	338,521	43,669	3,104,956	139,723	.....	.....	456,504
Lyon	.....	.....	.....	.....	.....	.....	183,629
Mineral	6,184	798	111,500	5,017	.....	.....	160,998
Nye	166	21	47,275	2,127	.....	.....	6,042,036
Ormsby	305	39	.....	.....	.....	.....	222
Pershing	1,020	132	82,928	3,732	.....	.....	937,914
Storey	.....	.....	.....	.....	.....	.....	588,758
Washoe	35,901	4,631	635,084	28,579	.....	.....	209,291
White Pine	10,297,756	1,328,411	447,167	20,123	.....	.....	1,493,736
	10,961,491	1,414,032	7,188,768	323,495	69,397	3,470	12,137,536

Production from deep mines in Nevada in 1920 and 1921, by counties.

County.	Ore sold or treated, 1921 (short tons).		Number of deep mines producing.		Average value per ton.[a]		Average value per ton in gold and silver.[a]	
	Total.	Increase or decrease.	1920	1921	1920	1921	1920	1921
Churchill	70	− 1,222	9	9	$31.85	$89.49	$31.07	$64.44
Clark	1,471	− 28,431	34	15	47.79	72.65	10.87	58.85
Douglas	4	+ 4	.....	2	.....	21.50	.....	21.50
Elko	54,174	− 10,586	35	26	16.64	17.29	12.08	16.00
Esmeralda	25,906	+ 1,608	43	26	22.39	26.14	21 97	26.01
Eureka	9,744	+ 774	23	15	41.95	16.21	17.28	9.88
Humboldt	294	− 289	17	11	79.96	148.95	73.10	148.25
Lander	3,659	− 71	22	18	29.65	16.37	19.49	14.49
Lincoln	35,088	− 82,566	23	25	11.71	13.01	5.47	7.78
Lyon	8,932	− 47,728	21	23	6.76	5.27	3.36	5.27
Mineral	7,112	− 1,337	43	34	21.13	22.62	18.09	21.80
Nye	383,064	− 46,604	53	71	15.77	15.36	15.65	15.35
Ormsby	4	+ 4	.....	1	.....	55.50	.....	45.75
Pershing	91,587	+ 14,004	40	39	11.14	10.24	11.03	10.20
Storey	64,601	+ 6,107	20	17	11.56	9.11	11.56	9.11
Washoe	8,093	+ 6,752	15	11	28.54	25.86	22.52	21.76
White Pine	402,335	−2,194,901	36	27	3.77	3.71	.24	.36
	1,096,138	−2,384,482	434	370	6.82	10.73	3.41	9.15

[a] Placer product excluded.

Production from placer mines in Nevada in 1920 and 1921, by counties.

County.	1920.						1921.					
	Mines.			Gold.	Silver (fine ounces).	Total value.	Mines.			Gold.	Silver (fine ounces).	Total value.
	Hydraulic.	Drift.	Dredge.				Hydraulic.	Drift.	Dredge.			
Douglas							1			$48		$48
Elko	3			$128		$128	6			1,951	36	1,987
Esmeralda	2			462	3	465	2			574	1	575
Eureka	2			292	1	293	1			414	2	416
Humboldt	1			538	5	544	1			498	4	502
Lander	3	2		24,618	176	24,810	10	2		71,750	509	72,259
Lyon			1	27,169	726	27,960			1	133,020	3,523	136,543
Mineral							2			136	5	141
Nye	[a] 18	4		98,601	2,375	101,190	[a] 29	4		154,463	3,874	158,337
Pershing	1			71	1	72	1			87	1	88
White Pine	2			760	9	770	1			201	1	202
	32	6	1	152,639	3,296	156,232	54	6	1	363,142	7,956	371,098

[a] Part of operations drifting and sluicing.

ORE.

Of the various kinds of ore mined in Nevada in 1921 silver ore was mined in greatest quantity, closely followed by copper ore. The total values of the ores not shown in the accompanying table are as follows: Dry gold ore, $1,158,444; dry gold and silver ore, $696,848; dry silver ore, $7,540,185; copper ore, $1,448,590; lead ore, $885,552; copper-lead ore, $31,337; lead-zinc ore, $5,482. The placer output, valued at $371,098, makes the total for the State $12,137,536.

Ore and metal produced in Nevada in 1921.

Source of production.	Ore.		Gold.		Silver.	
	Short tons.	Per cent.	Fine ounces.	Per cent.	Fine ounces.	Per cent.
Dry gold ore	63,850	5.82	50,699.95	31.63	109,323	1.54
Dry gold and silver ore	60,365	5.51	18,969.68	11.85	265,983	3.76
Dry silver ore	543,345	49.57	63,625.31	39.70	6,164,208	87.02
Copper ore	401,153	36.60	4,747.21	2.96	19,323	.27
Lead ore	25,597	2.34	4,614.98	2.88	496,826	7.01
Copper-lead ore	1,689	.15	30.50	.02	20,163	.29
Lead-zinc ore	139	.01				
Total deep mines	1,096,138	100.00	142,687.63	89.04	7,075,826	99.89
Total placers			17,566.99	10.96	7,956	.11
Total, deep and placers, 1921	1,096,138	100.00	160,254.62	100.00	7,083,782	100.00
Total, deep and placers, 1920	3,480,620		172,540.46		7,745,093	
Decrease, 1921	2,384,482		12,285.84		661,311	

Source of production.	Copper.		Lead.		Zinc.	
	Pounds.	Per cent.	Pounds.	Per cent.	Pounds.	Per cent.
Dry gold ore	4,160	0.04	11,616	0.16		
Dry gold and silver ore	205,142	1.87	272,533	3.79		
Dry silver ore	20,687	.19	1,290,158	17.95		
Copper ore	10,318,851	94.14	21			
Lead ore	384,739	3.51	5,415,434	75.33		
Copper-lead ore	27,912	.25	154,288	2.15		
Lead-zinc ore			44,718	.62	69,397	100.00
Total deep mines	10,961,491	100.00	7,188,768	100.00	69,397	100.00
Total deep mines, 1920	50,559,763		21,263,700		10,698,040	
Decrease, 1921	39,598,272		14,074,932		10,628,643	

GOLD ORE.

The gold ores, largely dry or siliceous, were mined by 122 producers in 1921, compared with 106 producers in 1920. These ores averaged $16.41 in gold and 1.71 ounces of silver to the ton and were valued at $18.14 a ton. Nye County had the largest number of gold ore producers—27, who reported 4,265 tons, mainly from the Round Mountain district, followed by the Manhattan district. Elko County, with only 10 gold ore producers, had the greatest output, 38,346 tons, largely from the Jarbidge and Gold Circle districts. The largest producers of gold ore were the Elkoro mine, at Jarbidge; the Goldfield Consolidated, at Goldfield; and the Olympic mine, in the Bell district.

Content of dry gold ores sold or treated in Nevada in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Churchill	2	1.63	2	.....	.....
Clark	472	341.49	168	.....	.....
Douglas	4	3.98	3	.....	.....
Elko	38,346	23,488.85	89,276	.....	.....
Esmeralda	6,288	8,078.91	4,391	3,827	439
Eureka	119	75.62	101	.....	.....
Humboldt	19	916.00	1,405	.....	.....
Lander	2,967	437.14	1,021	333	11,177
Lyon	1,248	927.11	645	.....	.....
Mineral	6,032	4,778.85	3,997	.....	.....
Nye	4,265	8,903.42	5,345	.....	.....
Pershing	1,601	1,105.28	1,651	.....	.....
Storey	2,282	1,237.41	1,203	.....	.....
Washoe	92	158.34	60	.....	.....
White Pine	113	245.91	55	.....	.....
	63,850	50,699.94	109,323	4,160	11,616

GOLD AND SILVER ORES.

Gold and silver ores were mined in 11 counties by 21 producers. The average of the output was $6.49 in gold and 4.41 ounces of silver to the ton, 0.17 per cent of copper, and 0.23 per cent of lead. Six producers reported 38,814 tons from Storey County, mined in the Comstock district; the next largest quantity was mined in the Gold Circle district, Elko County. At Eureka the old slag dump of the Richmond-Eureka smelter produced considerable speiss, which is included as ore in this report and helps to bring the total of Eureka County to third place in the output of gold and silver ores. This old slag from Eureka County also contained considerable copper and lead.

Content of dry gold and silver ores sold or treated in Nevada in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Churchill	9	24.74	650	.....	.....
Clark	2	1.05	22	.....	.....
Elko	12,586	5,639.65	82,675	.....	.....
Eureka	8,646	1,536.32	24,211	205,142	272,533
Humboldt	24	86.00	1,417	.....	.....
Lander	1	1.07	14	.....	.....
Mineral	39	160.77	4,893	.....	.....
Nye	2	15.00	256	.....	.....
Pershing	237	103.73	2,667	.....	.....
Storey	38,814	11,376.92	148,742	.....	.....
Washoe	5	24.43	436	.....	.....
	60,365	18,969.68	265,983	205,142	272,533

SILVER ORE.

The output of siliceous silver ore was mined by 133 producers and averaged $2.42 in gold and 11.34 ounces of silver to the ton and 0.12 per cent of lead. Included in the output reported as silver ore was 19,410 tons of iron-manganese ore, containing lead and small quantities of gold, silver, and copper, produced in the Pioche district. The Tonopah district, in Nye County, was the largest producer of silver ore and was credited with 367,909 tons, produced from 25 properties.

Content of dry silver ores sold or treated in Nevada in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Churchill	4	3.60	143	.....	.....
Clark	5	3.22	4,839	19	19
Elko	56	4.03	2,776	278	1,608
Esmeralda	19,346	2,921.96	438,858	33	766
Humboldt	247	66.99	18,575	370	2,791
Lander	129	73.86	7,038	527	6,890
Lincoln	23,319	116.84	92,701	17,380	1,246,588
Lyon	7,684	454.26	17,886	.....	.....
Mineral	162	244.99	31,393	364	3,910
Nye	378,691	48,404.84	4,682,490	.....	15,298
Pershing	89,523	8,120.26	726,827	446	540
Storey	23,505	3,099.18	113,986	.....	.....
Washoe	2	.....	102	.....	.....
White Pine	672	111.27	26,594	1,270	11,748
	543,345	63,625.30	6,164,208	20,687	1,290,158

COPPER ORE.

There were seven producers of copper ore in 1921. The ore averaged 24 cents in gold and 0.05 ounce of silver to the ton and 1.29 per cent of copper and was valued at $3.61 a ton. The Robinson district, White Pine County, where the largest output was mined, was active only in the first part of the year.

Content of copper ores sold or treated in Nevada in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Clark	1	0.04	750	97	21
Lander	381	772.42	4,858	26,874	.....
Mineral	45	.....	405	5,400	.....
Ormsby	4	.06	182	305	.....
Washoe	5	.98	84	4,095	.....
White Pine	400,717	3,973.71	13,044	10,282,080	.....
	401,153	4,747.21	19,323	10,318,851	21

LEAD ORE AND COPPER-LEAD ORE.

The producers of lead ore numbered 88. The average content of the ore was $3.73 in gold and 19.41 ounces of silver to the ton, 1.75 per cent of copper, and 10.58 per cent of lead, and the ore was valued at $34.59 a ton. Most of the lead ore was mined in Lincoln

County, in the Pioche and surrounding districts; Washoe and Elko counties produced the next largest outputs.

The output of copper-lead ore was reported by five producers. The average content was 37 cents in gold and 11.94 ounces of silver to the ton, 0.83 per cent of copper, and 4.57 per cent of lead, and the average value was $18.55 a ton.

Content of lead ores sold or treated in Nevada in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Churchill	55	2.65	3,042	194	38,393
Clark	852	3,256.98	6,315	31,131	239,459
Elko	3,110	3.29	87,640	5,583	1,503,167
Esmeralda	272	27.58	2,576	384	59,819
Eureka	979	827.05	21,590	1,806	504,410
Humboldt	4	.84	75	87	454
Lander	181	24.87	13,033	667	52,777
Lincoln	11,769	309.25	171,603	321,141	1,858,368
Mineral	834	15.03	6,868	420	107,590
Nye	106	35.69	7,745	166	31,977
Pershing	226	54.89	8,829	574	82,388
Washoe	6,533	14.98	155,893	19,966	599,545
White Pine	676	41.88	11,617	2,620	337,087
	25,597	4,614.98	496,826	384,739	5,415,434

Content of copper-lead ores sold or treated in Nevada in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Elko	76	3.03	2,036	4,286	20,417
Washoe	1,456	25.62	14,868	11,840	35,539
White Pine	157	1.85	3,259	11,786	98,332
	1,689	30.50	20,163	27,912	154,288

LEAD-ZINC ORE.

Lead-zinc ore was produced from only one mine, which operated in the Yellow Pine district, Clark County. The ore contained an average of 16.09 per cent of lead and 24.96 per cent of zinc and was valued at $39.44 a ton. No zinc ore was marketed in 1921.

METALLURGIC INDUSTRY.

Fifty milling plants were reported in operation in Nevada in 1921. Of these plants 17 used the amalgamation process, 9 concentration (5 of which had flotation units), 14 cyanidation, 1 amalgamation and cyanidation, 4 concentration and cyanidation, and 5 amalgamation and concentration.

About 224 pounds of mercury was purchased for use in amalgamation, and 1,107,530 pounds of sodium cyanide was used.

Gold and silver produced from Nevada mills in 1921.

County.	Ore (short tons).	Bullion (fine ounces) recovered from ore by—				Total value.
		Amalgamation.		Cyanidation.		
		Gold.	Silver.	Gold.	Silver.	
Churchill	2			1.63	2	$36
Clark	174	276.13	123	[a] 66.41	[a] 67	7,271
Douglas	4	3.98	3			85
Elko	[b] 50,932	205.29	161	28,909.74	171,719	773,741
Esmeralda	[c] 23,951	3.42	200	[d] 8,805.11	[d] 439,231	621,519
Eureka	100	55.07	16			1,154
Humboldt	4			3.53	9	82
Lander	[e] 2,968	201.20	184			4,343
Lyon	1,265	915.00	634	[f] 421.16	[f] 13,672	41,927
Mineral	6,073	64.55	25	4,717.78	8,615	107,500
Nye	[g] 347,746	8,739.57	5,148	[h] 48,537.47	[h] 4,665,571	5,854,741
Pershing	[i] 90,934	1,037.90	3,570	[j] 8,040.79	[j] 697,317	888,560
Storey	62,821	1,189.04	1,042	[k] 14,433.47	[k] 261,136	585,124
Washoe	92	158.34	60			3,333
White Pine	163	245.91	55	.69	663	5,816
	587,229	13,095.40	11,221	113,937.78	6,258,002	8,895,232

[a] Includes bullion from 300 tons of old tailings.
[b] Also yielded 4 tons of concentrates.
[c] Also yielded 2 tons of concentrates.
[d] Includes bullion from 300 tons of old tailings.
[e] Also yielded 36 tons of concentrates.
[f] Includes bullion from 7,580 tons of old tailings.
[g] Also yielded 50 tons of concentrates.
[h] Includes bullion from 33,709 tons of old tailings.
[i] Also yielded 14 tons of concentrates.
[j] Includes bullion from 42 tons of old tailings.
[k] Includes bullion from 1,773 tons of old tailings.

The output of milling ores was 990,624 tons, of which 587,229 tons was treated by amalgamation or cyanidation and 403,395 tons by concentration, followed by smelting. The 574,086 tons of ore and 43,704 tons of tailings treated by cyanidation contained an average per ton of $3.81 in gold and 10.13 ounces of silver. The ores amalgamated (13,143 tons) yielded bullion averaging $20.60 in gold and 0.85 ounce of silver per ton of ore treated. About 37 per cent of the total ore was of concentrating grade and produced concentrate which was valued at $34.58 a ton. The output by counties and the average assay of the product follow:

Mine production of gold, silver, copper, and lead from Nevada concentrates in 1921.

By counties.

County.	Ore to concentrating mills.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Total value of concentrates.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Elko	15	6	16.21	774	.....	.....	$1,109
Esmeralda	205	48	252.51	1,839	138	34,978	8,650
Humboldt	2	1	.56	.....	.....	.....	12
Lander	.....	36	237.01	851	333	11,177	6,296
Lincoln	174	29	7.21	648	.....	12,925	1,379
Lyon	30	1	17.14	697	.....	.....	1,051
Mineral	768	96	.....	3,171	.....	93,539	7,380
Nye	1,510	140	31.44	17,399	.....	15,771	18,759
Pershing	102	48	2.69	4,196	.....	.....	4,252
Washoe	7,944	980	38.93	166,206	31,440	611,877	198,601
White Pine	392,645	41,376	3,882.29	12,582	8,824,837	.....	1,231,240
	403,395	42,761	4,485.99	208,363	8,856,748	780,267	1,478,729

By kinds of concentrates.

Dry or siliceous	.....	151	314.04	18,062	138	5,241	$24,808
Copper	.....	41,376	3,882.29	12,582	8,824,837	.....	1,231,240
Lead	.....	1,052	264.04	162,851	19,933	739,487	204,157
Copper-lead	.....	182	25.62	14,868	11,840	35,539	18,524

Average content.

Kind of concentrates.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	
Dry or siliceous	151	2.08	119.62	0.05	1.74	$164.29
Copper	41,376	.09	.30	10.66	.....	29.76
Lead	1,052	.25	154.80	.95	35.15	194.06
Copper-lead	182	.14	81.69	3.25	9.76	101.78
	42,761	.10	4.87	10.36	.91	34.58

The oxidized lead ore, largely carbonates, of smelting grade decreased from 20,213 tons in 1920 to 16,585 tons in 1921 and averaged $5.58 in gold, 18.69 ounces of silver, 21.80 pounds of copper, 265.56 pounds of lead, and $39.04 in total value to the ton. The sulphide lead ores of smelting grade averaged $1.66 in gold, 21.95 ounces of silver, 2.62 pounds of copper, 215.03 pounds of lead, and $33.63 in total value to the ton. The production of copper-lead ores decreased from 6,269 tons to 1,689 tons, of which 233 tons was shipped directly to smelters. Nearly all the first-class ore (208 tons) was oxidized or carbonate copper-lead ores, averaging $0.24 in gold, 21.10 ounces of silver, 69.52 pounds of copper, 556.07 pounds of lead, and $55.33 in total value to the ton. All the lead-zinc ore produced was shipped directly to the smelter.

Mine production of gold, silver, copper, lead, and zinc from Nevada crude ore shipped to smelters in 1921.

By counties.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Churchill	68	30.99	3,835	194	38,393	.....	$6,229
Clark	997	3,260.24	11,904	31,247	284,217	69,397	99,590
Elko	3,227	7.61	91,749	10,147	1,525,192	.....	161,849
Esmeralda	450	1,967.41	4,555	4,106	26,046	.....	46,927
Eureka	1,020	860.60	21,834	1,961	505,251	.....	62,613
Humboldt	288	1,065.74	21,463	457	3,245	.....	43,699
Lander	691	871.15	24,929	28,068	59,667	.....	49,243
Lincoln	34,914	418.88	263,656	338,521	3,092,031	.....	455,125
Lyon	57	28.07	3,528	.....	.....	.....	4,108
Mineral	269	414.31	35,288	6,184	17,961	.....	45,459
Nye	99	50.47	7,718	166	31,504	.....	10,199
Ormsby	4	.06	182	305	.....	.....	222
Pershing	446	267.78	30,153	1,020	82,928	.....	39,553
Storey	7	91.00	1,753	.....	.....	.....	3,634
Washoe	57	27.08	5,177	4,461	23,207	.....	7,356
White Pine	9,527	245.73	41,269	1,472,919	447,167	.....	256,479
	52,121	9,607.12	568,993	1,899,756	6,136,809	69,397	1,292,285

By kinds of ore.

Dry or siliceous	25,289	4,145.37	216,889	24,531	1,275,001	.....	$363,121
Copper	8,508	864.92	6,741	1,494,014	21	.....	217,350
Lead	17,952	4,591.95	340,068	365,139	4,698,320	.....	693,519
Copper-lead	233	4.88	5,295	16,072	118,749	.....	12,813
Lead-zinc	139	.....	.....	.....	44,718	69,397	5,482

Average content.

Kind of ore.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*	
Dry or siliceous	25,289	0.16	8.58	0.05	2.52	.....	$14.36
Copper:							
Oxidized	1,824	.42	2.00	2.50	.....	.....	17.21
Sulphide	6,684	.01	.46	10.49	.....	.....	27.82
Lead:							
Oxidized	16,585	.27	18.69	1.09	13.28	.....	39.04
Sulphide	1,367	.08	21.95	.13	10.75	.....	33.63
Copper-lead:							
Oxidized	208	.01	21.10	3.48	27.80	.....	55.33
Sulphide	25	.10	36.28	3.22	6.17	.....	52.20
Lead-zinc (oxidized)	139	.....	.....	.....	16.09	24.96	39.44
	52,121	.18	10.92	1.82	5.89	.....	24.79

GOLD.

Nye County had the largest output of gold in 1921, and Elko, Storey, and Esmeralda counties followed. Ore was treated by amalgamation in 13 counties and by cyanidation in 11 counties. By these two methods of treatment $2,626,009 in gold was produced from 587,229 tons of ore and 43,704 tons of old tailings. Placer gold was produced in greatest quantity in Nye, Lyon, and Lander counties, and the value of the total placer gold was $363,142, as against $152,639 in 1920. A large part of the placer gold in 1921 was obtained by dredging operations at Gold Canyon, in Lyon

County, and by hydraulic work in the Round Mountain district, Nye County, and the Battle Mountain district, Lander County.

Ten producers supplied nearly 66 per cent of the total gold in 1921. Their properties, which yielded more than 5,000 ounces each, were the Elkoro mines, at Jarbidge; Tonopah Belmont, Tonopah Extension, and West End, at Tonopah; Consolidated Virginia, at Virginia City; Round Mountain Mining Co., at Round Mountain; Rochester Silver, at Rochester; Gold Canyon Dredging Co., in Lyon County; Goldfield Consolidated, at Goldfield; and Elko Prince, in the Gold Circle district.

SILVER.

The mine production of silver decreased $1,358,369 in value, as compared with 1920. Milling plants in Nye County were credited with 4,670,719 ounces, most of which (4,665,571 ounces) was recovered by cyanidation from ores treated principally in the Tonopah district. In the Rochester district, Pershing County, 659,048 ounces of silver was recovered by cyanidation. Concentrates from milling plants yielded 208,363 ounces of silver, against 301,077 ounces in 1920. Siliceous concentrates contained 18,062 ounces, against 99,973 ounces in 1920; and copper concentrates 12,582 ounces, against 65,529 ounces in 1920. Lead concentrates contained 162,851 ounces of silver, or an average per ton of 154.80 ounces, against 135,440 ounces, or an average of 45.18 ounces, in 1920.

More than 64 per cent of the total silver was produced from the Tonopah Belmont, West End, Tonopah Extension, and Tonopah Mining, all at Tonopah; and the Rochester Silver, in Pershing County.

COPPER.

The mine production of copper in Nevada in 1921 decreased $7,888,964 in value. The mine of the Nevada Consolidated Co., at Ely, in White Pine County, which was closed in April, was the largest producer. Other large producers were the Bristol Silver mines, near Pioche; and the Richmond-Eureka mine, in Eureka County. The Mason Valley copper smelter, at Thompson, remained idle.

LEAD.

The mine production of lead in Nevada in 1921 decreased more than 66 per cent. Lincoln County continued to have the largest output of lead, followed by Elko County. Nearly 11 per cent of the lead was derived from the concentrates of milling ores, and more than 85 per cent from crude ore shipped directly to smelters. Lead concentrates (carbonates and sulphides) shipped to smelters contained 739,487 pounds of lead, against 2,558,645 pounds in 1920, and averaged 35.15 per cent of lead, against 42.67 per cent in 1920. The total crude ore of shipping grade contained 6,136,809 pounds of lead, against 17,795,649 pounds in 1920. The iron-manganese ores, classified under dry or siliceous ores, contained 1,162,241 pounds of lead. Oxidized lead ore shipped to smelters contained 4,404,370 pounds of lead, and sulphide ore 293,950 pounds, against 8,095,983 pounds and 2,487,263 pounds, respectively, in 1920. Copper-lead ore of shipping grade, most of which was oxidized, produced 118,749

pounds of lead. The oxidized lead-zinc ores of smelting grade produced 44,718 pounds of lead.

More than 69 per cent of the lead came from seven mines. The leading producer was the Bristol Silver mine, near Pioche, Lincoln County, followed by the Spruce Monarch, Elko County; the Prince Consolidated, Lincoln County; the Leadville, Washoe County; the Delno, Elko County; the Virginia Louise, Lincoln County; and the Eureka Holly, Eureka County.

ZINC.

The output of zinc in Nevada in 1921 was made by one producer in the Yellow Pine district, Clark County. On account of the poor market for zinc ore and high freight rates, no shipments were made from the Yellow Pine mine, a large producer in past years.

MINING INDUSTRY IN NEVADA.

The most notable event of the year was the revival of mining in the Comstock district and the initiation of new large enterprises in that famous camp. Much activity in prospecting was recorded and a number of promising discoveries were reported, but the scarcity of funds for development precluded the opening of new prospects, except in a few places such as Argentite, in the Silver Peak region, and Royston or the San Antone district, in Nye County. In the larger silver camps mine development was intensified in the effort to take advantage of the stabilized price of silver, but no new gold mines were opened. Copper, lead, and zinc mining practically stopped early in the year.

On April 16 the wages of all classes of labor at Tonopah and Divide were reduced 75 cents a day. A strike was immediately declared, and operations were suspended at several of the mines and mills and were interrupted at others. On August 16 the reduced scale of wages was accepted, and shortly thereafter normal conditions were reestablished. The serious effect of the strike is reflected in the statements of the mining companies showing increased costs and loss of production during the period of suspension. This is the third consecutive year for labor strikes in the Tonopah district.

REVIEW BY COUNTIES.

CHURCHILL COUNTY.

Broken Hills district.—Silver-lead ore was shipped by the Broken Hills Corporation, which is developing property near the junction of Nye, Mineral, and Churchill counties. Ore of similar character was also shipped from the Silver Trailer property, in the vicinity of Broken Hills.

Fairview district.—Small quantities of ore containing lead and silver were shipped to the smelter from the Fairview district. The largest shipment of lead ore was from the property of the Chalk Mountain Silver Lead Mining Co.

Holy Cross district.—A small lot of siliceous gold-silver ore was shipped from the Last Hope claim.

Jessup district.—A small lot of siliceous silver ore was shipped to the smelter from the property of the Jessup King Mining Co.

Wonder district.—No development work was reported in the Wonder district, but a small lot of gold bullion was shipped, which probably came from mill cleanings.

CLARK COUNTY.

Mine production in Clark County, Nev., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	34	29,902	$121,358	186,945	121,508	4,018,864	9,381,503	$1,428,896
1921	15	1,471	74,476	12,094	31,247	284,217	69,397	106,861
Decrease, 1921	19	28,431	46,882	174,851	90,261	3,734,647	9,312,106	1,322,035

Eldorado Canyon district.—The Techatticup and other properties in the Eldorado Canyon district were idle. Only a small quantity of gold and silver bullion from former operations was credited to the district.

Searchlight district.—Nine producers in the Searchlight district reported an output of 882 tons of ore and 300 tons of old tailings. Of the total output 710 tons of ore was shipped directly to smelters and contained 3,259.15 ounces of gold, 9,709 ounces of silver, 31,128 pounds of copper, and 98,048 pounds of lead. At milling plants 172 tons of ore and 300 tons of old tailings were treated and yielded bullion containing 341.49 ounces of gold and 168 ounces of silver. Most of the shipping ore came from the Duplex property, which was operated by lessees. Smaller lots of ore from the Good Hope, Quartette, Peerless, and St. Louis properties were treated in the district. Old tailings from the Cyrus Noble dump were treated by cyanidation.

Yellow Pine district.—All the ore produced in the Yellow Pine district came from the operation of five properties. Of the 287 tons of ore produced, the largest part came from the Bullion mine, and smaller lots were shipped from the Bonanza, Ingomar, Milford No. 2, and Christmas Consolidated properties.

ELKO COUNTY.

Mine production in Elko County, Nev., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	38	64,760	$434,060	319,504	147,699	3,353,164	$1,077,749
1921	32	54,174	604,305	264,439	10,147	1,525,192	938,687
Increase or decrease, 1921	−6	−10,586	+170,245	−55,065	−137,552	−1,827,972	−139,062

[a] Includes placer production.

Cope district.—At the Nelson mine a 50-ton flotation plant was constructed and operated experimentally, producing a rich concentrate which was shipped to a smelter.

Delno district.—Important operations were reported at the property of the Delno Mines Co., which produced considerable lead ore containing silver.

Good Hope district.—Silver ore from the Midnight mine was shipped to the smelter.

Gold Circle district (*Midas*).—Nine producers in the Gold Circle district reported the output of 12,733 tons of ore, all of which was of milling grade, yielding bullion which contained $121,486 in gold and 82,961 ounces of silver, valued in all at $204,447, or $16.06 a ton. A small output of placer bullion was reported by one operator. The principal part of the production came from the Elko Prince property, which is equipped with a 50-ton cyanide plant. The reserve of gold and silver ore, calculated to the end of 1920, was valued at $253,324. Of this total, 850 tons of broken ore had an average value of $16.70 a ton; 9,956 tons of developed ore, $23.26 a ton; and 370 tons of probable ore, $20 a ton. Other properties producing milling ore were the Sleeping Beauty, Queen, Gold Circle, and Banner. Some of the ore was treated in Coot's custom mill.

Island Mountain district.—Ore from the Gold Center group was treated experimentally in an old 3-foot Huntington mill, which is also equipped with amalgamation plates and Wilfley concentrators. After the tests were made the mine was further developed by sinking from the 120-foot level.

Jarbidge district.—The only output in the Jarbidge district was recorded by the Elkoro Mines Co., whose 100-ton cyanide plant was operated continuously throughout 1921. The property was the largest gold producer in the State and was operated at a profit of $255,461.70. The report [2] of the Yukon Gold Co. gives the following paragraph regarding the property in Nevada:

> The operations of the Elkoro Mines Co. were confined to the Long Hike, Starlight, and O. K. mines. A total of 38,129 tons of ore was milled, which yielded $568,488. The average value of the ore milled was $15.88 per ton, and the average recovery $14.91 per ton. The total cost of mining and milling, excluding depreciation and development, was $253,178, or $6.64 per ton. Compared with the previous year, the value increased $6.19 per ton and the cost increased $1.12 per ton. The increased cost was due to the operations being divided among three mines and to a decrease in tonnage milled, due to the treating of the more difficult ores from the O. K. mine. Of the ore milled, 21,901 tons were drawn from reserves and 16,228 tons were from development during the year.

Loray district.—The Alabama claim produced siliceous silver ore, containing a little copper, which was shipped to a smelter in Utah. The mine is 5 miles from Loray, on the Southern Pacific Railroad.

Lone Mountain district.—Silver-lead sulphide ore was shipped to the smelter from the Rip Van Winkle property, operated by the Alaska Improvement Co. The ore deposit is a replacement in limestone near the contact with porphyry. The mine is opened for a depth of 300 feet on the vein.

Railroad (Bullion) district.—Two producers in the Railroad district reported the output of 76 tons of ore, all of shipping grade, containing principally silver and lead and valued at $3,571. The Bunker Hill and Sweepstake properties were the producers.

[2] Yukon Gold Co. Ann. Rept. for year ending Dec. 31, 1921.

Spruce Mountain district.—Altogether 1,897 tons of ore, produced by three operators, was reported from the Spruce Mountain district. The Spruce Monarch mine was the largest producer of ore, which averaged 17 per cent of lead and 20 ounces of silver to the ton. The ore reserve is estimated to be between 15,000 and 30,000 tons of ore which carries silver, lead, iron, a little arsenic and zinc, and about 0.5 per cent of copper. Tobar, on the Southern Pacific Railroad, 28 miles from the mine, is the shipping point. A lessee of the Ada H. property shipped lead-silver ore. Lead-silver ore from the Bullshead mine was hauled 17 miles to Jasper siding, on the Western Pacific Railroad. This property is opened by 5,000 feet of drifts, and the equipment includes a 30-ton lead blast furnace, which was idle in 1921.

Van Duser district.—One lot of silver ore was produced from the Protection claim, near Mountain City, and placer bullion reported by four producers was valued at $1,776.

ESMERALDA COUNTY.

Mine production in Esmeralda County, Nev., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	45	24,298	$219,470	288,885	13,962	95,743	$544,583
1921	28	25,906	228,552	445,826	4,244	61,024	677,671
Increase or decrease 1921	−17	+1,608	+9,082	+156,941	−9,718	−34,719	+133,088

[a] Includes placer production.

Cocomauga district.—One small lot of silver ore was shipped from the Silver Tip property.

Desert district.—Silver ore from the Black Mammoth property was hauled to Millers and treated in the MacNamara mill at Tonopah. The ore is siliceous in character and readily cyanided.

Goldfield district.—The ore output of the Goldfield district in 1921 had an average value of $31.80 a ton, against $25.02 in 1920. With the exception of 371 tons shipped to the smelter, the output was ore of milling grade. Placer bullion, valued at $575, was reported by two operators. Most of the ore was from the Goldfield Consolidated and Florence mines, which were operated almost entirely by lessees.

Mine production of Goldfield district, Nevada, 1920–21.

Year.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
	Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	6,571	$155,789	6,081	13,440	.....	$164,890
1921	4,668	146,782	1,761	3,689	.....	149,019
Decrease, 1921	1,903	9,007	4,320	9,751	.....	15,871
Total, 1904–1921	.....	82,507,585	1,345,027	7,556,252	27,540	84,807,691

[a] Includes placer production.

Gold Mountain (Divide) district.—Five producers in the Gold Mountain district reported the output of 14,883 tons of ore, contain-

ing $48,979 in gold, 364,269 ounces of silver, and a little lead and copper, valued in all at $413,530, or $27.79 a ton. With the exception of 20 tons containing lead and copper, all the ore was shipped to cyanidation plants at Tonopah. The Tonopah Divide mine produced the largest part of the output of the district, followed by the Divide Extension and Gold Zone Divide properties. The Butte-Goldfield and Silver Mary No. 2 mines furnished small lots of silver ore and a little lead ore.

Mine operations at Divide ceased on April 16 as a result of a labor strike, and work was not resumed until July 20. The Tonopah Divide mine [3] shipped by autotrucks to the mills at Tonopah 12,763 tons of gold and silver ore, valued at $336,275.30. After deducting $34,411.91 for metallurgical losses and $73,916.40 for mining and development, which, with other expenses, amounted to $198,176.19, a balance of $106,719.06 was left. After depreciation charges, the net profit was $101,559.08. The mine shaft was sunk an additional 584 feet in 1921, making a total depth of 1,229 feet. It is expected that water level will be found 200 feet deeper. From January 1, 1920, to the end of 1921 the mine produced 22,752 tons of shipping ore, valued at $26.48 a ton in gold and silver. During this time 6,346 tons of second-class ore, valued at $11.54 a ton, was added to the stock pile of milling ore.

Hornsilver district.—No ore was produced from the Hornsilver district in 1920, but development work at the Orleans property resulted in the shipment of considerable ore in 1921. The ore, which contains an average of 1 ounce of gold and 7 ounces of silver to the ton, was hauled 14 miles to Stonewall siding, on the Tonopah & Tidewater Railroad, for shipment to Tonopah, where it was treated by cyanidation.

Klondyke district.—Four producers in the Klondyke district reported the output of 3,190 tons of ore, containing $11,257 in gold and 54,340 ounces of silver, valued together at $65,597, or $20.56 a ton. For three of the properties—the Knox Divide, Golden State, and Original Klondyke—the output was equally divided. The output of all properties was shipped to Tonopah for treatment at cyanidation plants.

Lida (Tule Canyon) district.—Development work at the Bullion and Ingalls properties resulted in the principal part of the production recorded for the Lida district in 1921, which consisted of 901 tons of milling ore, yielding gold and silver, 205 tons of ore, yielding lead concentrates, and 12 tons of silver ore of shipping grade. Some tailing from the Ingalls property was re-treated.

Lone Mountain district.—Lead ore containing silver and a little gold from the Great Seal claim was the only output reported from the Lone Mountain district.

Silver Peak district.—The principal operations in the Silver Peak district were carried on at the old mill of the Silver Peak Co., where old tailings were re-treated by concentration. The concentrates carried principally gold and silver. Ore from the Vulcan property was also concentrated locally.

Tokop district.—The Blue Jay property produced silver-lead ore of smelting grade.

[3] Tonopah Divide Mining Co. Ann. Rept. for year ending Dec. 31, 1921.

EUREKA COUNTY.

Mine production in Eureka County, Nev., in 1920 and 1921.

Year	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	25	8,970	$63,760	84,006	121,029	2,487,210	$376,572
1921	16	9,744	50,833	45,904	206,948	776,943	158,395
Increase or decrease, 1921.	−9	+774	−12,927	−38,102	+85,919	−1,710,267	−218,177

[a] Includes placer production.

Eureka district.—The reports of 14 producers in the Eureka district gave an output of ore of shipping grade and considerable speiss from the old slag dumps of the Richmond-Eureka smelter. The total output of the district contained $49,280 in gold, 45,886 ounces of silver, 206,948 pounds of copper, and 776,943 pounds of lead, valued in all at $156,824, or $16.26 a ton. The Croesus, Holly, Cyanide, and Eureka Nevada properties were the principal producers of ore. Ore containing principally gold and silver was shipped to the smelter from the Silver Connor property. Lessees of several properties, including the Diamond and Excelsior mines, shipped smaller lots of ore.

Lynn district.—In the course of development work ore from the Lynn Big Six property was treated by amalgamation, and a little gold bullion was shipped to Salt Lake City, Utah.

HUMBOLDT COUNTY.

Black Rock district.—Silver ore from the Silver Camel property was shipped from Sulphur, on the Western Pacific Railroad.

Gold Run (Adelaide) district.—Three producers in the Gold Run district shipped 30 tons of ore, containing an average in gold and silver of $133.93 a ton. Placer bullion was reported by one operator.

Iron Point district.—Considerable silver ore containing a little lead was shipped to the smelter from the Silver Coin property.

National district.—The National Mines Co., the only operator in the National district, shipped a few tons of exceptionally rich gold ore. This property, which is operated by lessees, is opened by an incline shaft 1,100 feet deep. The mill has been dismantled.

New Goldfields district.—The Cotton Tail mine, near Rebel Creek, was being developed and one lot of gold ore was shipped to the smelter in 1921.

Winnemucca Mountain (Barrett Springs) district.—Four mines in the Winnemucca Mountain district produced 112 tons of ore, valued at $8,052, or $71.89 a ton. The ore contained principally gold and silver, and with the exception of 2 tons was shipped directly to the smelter. The largest producers were the Nineteen Ten and Bay Bee groups.

LANDER COUNTY.

Battle Mountain district.—Three producers of ore in the Battle Mountain district reported 947 tons, all except 96 tons, of milling grade. The total output of the district, including the bullion from 12 placer producers ($72,259), contained $75,998 in gold, 3,237 ounces of silver, 103 pounds of copper, and 12,834 pounds of lead, valued in all at $79,826. Most of the ore produced came from the Humbug property, in Galena Canyon, and was treated in the amalgamation mill on the Antimony King property. The Golden Sceptre group produced silver-lead ore, which was shipped for smelting, and a small quantity of ore that was treated in a 2-stamp amalgamation mill. A little silver-lead ore was also produced from the Silver Horde claim.

Bullion district.—Four producers in the Bullion district reported an output of 199 tons of ore of shipping grade, containing $526 in gold, 5,996 ounces of silver, 13,060 pounds of copper, and 18,188 pounds of lead, valued in all at $9,025, or $45.35 a ton. The Gem mine produced the largest quantity of ore, part of which was shipped to Toulon, near Lovelocks, for reduction. Sulphide copper ore containing gold and silver was shipped to Midvale, Utah. This property is opened by an inclined shaft 450 feet deep, and the ore mined contains pyrite, chalcopyrite, and arsenopyrite. Beowawe, 23 miles from the mine, on the Southern Pacific Railroad, is the loading station for the ore.

Cortez district.—Two mines on the Lander County side of the Cortez district produced 85 tons of ore, containing gold, silver, lead, and a little copper, valued in all at $9,829, or $115.64 a ton. Considerable development work was done by the Consolidated Cortez Silver Mines Co., and the lower adit was driven to the 2,570-foot point. Several lots of oxidized lead ore were shipped by lessees. The loading station is Beowawe, on the Southern Pacific Railroad, 36 miles from the mine. A small quantity of silver-lead ore of shipping grade was also produced from the Utah mine.

Hilltop district.—The Hilltop Nevada Mining Co. shipped partly oxidized copper ore, containing considerable gold and silver. The oxidized zone is said to extend to a depth of 600 feet. The mine is opened by a vertical shaft 350 feet deep, drifts and crosscuts approximating 9,000 feet, and 1,200 feet of adits. Battle Mountain, 18 miles from the mine, is the loading station for the ore. Several lots of silver ore came from the Kattenhorn and Gray Eagle properties.

Jackson district.—Concentrate and a little gold bullion were shipped from the Star of the West mine, about 50 miles from Austin. The ore was treated in a 50-ton amalgamation mill, equipped for concentration and flotation, which was constructed in 1921.

Lewis district.—Development in the Betty O'Neal mine consists of a shaft 330 feet deep and about 6,000 feet of tunnels. Rich sulphide silver ore has been developed, and a milling plant is expected to be in operation on the property in 1922.

Reese River district.—A small lot of silver ore was shipped from the property operated by the Austin Dakota Development Co. and one lot of oxidized silver-lead ore by the Austin Manhattan Consolidated Silver Mines. The latter property has a 30-stamp concentration mill, but it was not operated in 1921.

LINCOLN COUNTY.

Mine production in Lincoln County, Nev., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	23	117,654	$24,833	567,678	553,186	7,904,470	$1,377,746
1921	25	35,088	8,808	264,304	338,521	3,104,956	456,504
Increase or decrease, 1921	+2	−82,566	−16,025	−303,374	−214,665	−4,799,514	−921,242

Comet district.—Oxidized iron-lead-silver ore was shipped from the Stella and Comet mines and one lot of silver ore from the Mount Comet mine. Each of the properties has been considerably developed, and the ore mined is hauled 16 miles to Comet siding, on the Caliente-Pioche branch of the Los Angeles & Salt Lake Railroad.

Ferguson district (Delamar).—The Magnolia mine, near Delamar, produced one lot of siliceous ore.

Freiberg district.—One lot of lead ore containing silver was shipped by lessees from property near Freiberg.

Highland district.—Several lots of oxidized lead ore containing silver were shipped from the Hamburg and Yankee Boy groups. The Gypsy claim produced a car of silver ore. These properties are 7 to 9 miles northwest of Pioche.

Jack Rabbit district.—Five producers in the Jack Rabbit district shipped 14,156 tons of first-class smelting ore. The bulk of the output was mined at the Black Metal and Bristol Silver mines, both of which are extensively developed. The Black Metal produced several thousand tons of silver ore, and the Bristol Silver shipped oxidized lead ore at the rate of nearly 900 tons a month. Rich silver ore was opened at the Silver Horn property, a new producer of the Jack Rabbit district.[4]

Patterson district.—Construction was begun in 1921 for a 50-ton cyanide plant on the Lake Valley mine. In the meantime several lots of siliceous silver ore were shipped to the smelter. The property is opened by a vertical shaft 45 feet deep and has 300 feet of drifts.

Pioche district.—The output of the Pioche district in 1921 was far below normal, as the Prince Consolidated mine, the largest producer, ceased shipping in March. The ore output decreased from 101,778 tons in 1920 to 20,679 tons in 1921. Nearly all the ore was of shipping grade, but the total included 174 tons of ore from which lead concentrate was produced. Although 10 producers reported, the bulk of the ore came from the Prince Consolidated and Virginia Louise mines, each of which produced oxidized iron-manganese ore, containing lead and silver. The ore is particularly valuable to the smelters on account of its fluxing qualities. Lessees of the Amalgamated Pioche property, including the Combined Metals (Inc.), shipped considerable high-grade sulphide silver-lead ore. Small lots of lead ore were shipped from the Yuba East and Mendha mines. At the Bullionville tailing dump of the Prince Consolidated Co. tests were made and as a result a little concentrate was shipped in 1921.

[4] Crampton, T. H. M., The Silver Horn district, near Pioche: Min. and Sci. Press, vol. 122, p. 883, 1921.

Concentration may prove to be the method adapted to the successful treatment of these tailings.

LYON COUNTY.

Mine production in Lyon County, Nev., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	
1920	22	56,660	$115,846	94,285	1,045,944	$411,071
1921	24	8,932	161,575	22,054	.....	183,629
Increase or decrease, 1921	+2	−47,728	+45,729	−72,231	−1,045,944	−227,442

[a] Includes placer production.

Silver City (Pelmyra) district (Dayton and Como).—The value of the output made by 19 operators of deep mines and one placer in the Silver City district was $177,210. Ore was shipped to the local amalgamation and cyanidation plants by lessees who worked on a number of properties. The bullion from 1,153 tons of ore and 7,580 tons of tailings, which had accumulated in the ponds below the amalgamation mills, yielded 1,227.99 ounces of gold and 13,512 ounces of silver. The Gold Canyon Dredging Co., a large producer of gold in 1921, operating in Gold Canyon below Silver City, has experienced some trouble since the dredge was turned down the canyon on account of a 3½ per cent grade. A system of levees was later constructed to hold the water. Large boulders also hindered the operations to some extent.

Talapoosa district.—Several lots of silver ore were shipped by the Talapoosa Co., which reports approximately 10,000 feet of development work on the property, 6 miles from Apache, on the Southern Pacific Railroad. Part of the output was tested by cyanidation at Millers.

Yerington district.—Three producers in the Yerington district reported 96 tons of ore, containing $2,181 in gold and 1,346 ounces of silver, valued in all at $3,527. The principal operations in the district were carried on at the May Adams property, 10 miles northwest of Yerington, in Mason Pass. On this property a 10-ton amalgamation mill was operated in July and produced a little gold and silver bullion. The copper mines were idle.

MINERAL COUNTY.

Mine production in Mineral County, Nev., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	43	8,449	$88,496	59,021	70,886	158,555	$178,556
1921	36	7,112	[a] 107,622	[a] 47,561	6,184	111,500	160,998
Increase or decrease, 1921	−7	−1,337	+19,126	−11,460	−64,702	−47,055	−17,558

[a] Includes placer production.

Bell district (Mina and Omco).—The 60-ton cyanide mill of the Olympi Mines Co. was operated until July 1 and then closed indefinitely. The bullion shipped in 1921 contained gold and silver. This property is 26 miles from Mina, on the Southern Pacific Railroad. At the Simon Silver-Lead property a 200-ton flotation mill was completed in November, 1921. The ore was treated mostly for experimental and adjustment purposes, and several lots of lead concentrate were shipped. A recent bulletin [5] reviews the geology of the district.

Columbus district.—Construction work was begun in December on a 300-ton milling plant for the Candelaria Mines. According to the annual report of the company,[6] the milling ore available is estimated at 610,000 tons, from which a profit of $1,600,000 may be realized. The history and geology of the Candelaria district were given in a recent bulletin [7] published by the Geological Survey.

Garfield district.—The Silversides and Mabel groups were operated in 1921. Lead ore and silver ore were shipped to the smelter and siliceous silver ore was shipped to the West End mill at Tonopah.

Hawthorne district.—The property of the Mandich Mining Co., opened by an inclined shaft 150 feet deep, was developed, and the gold ore produced was treated in a five-stamp amalgamation mill completed in 1921.

Holy Cross district.—One lot of copper ore containing silver was shipped to the sampler at Hazen from the Billy Boy property of the Mineva Mining Co.

Mount Grant district.—A two-stamp amalgamation mill was operated on ore from the Mammoth property and a little gold bullion was shipped.

Rand district.—The principal producer in the Rand district was the Rand mine, which shipped 20 tons of rich siliceous gold and silver ore. Both oxidized and sulphide ores were produced from replacement veins in trachyte-andesite. The mine is developed by a 450-foot vertical shaft and the total development work amounts to about 2,500 feet. The mine is 17 miles from the Southern Pacific Railroad and ore is hauled to Nolan switch.

Regent (Rawhide) district.—Eleven producers of ore and two producers of bullion from surface operations in the Regent district reported an output valued at $14,984. Lessees on different properties produced 93 tons of ore, containing $5,315 in gold and 9,528 ounces of silver. The principal operations were on the Nevada New mines and Buckskin Mountain properties.

Santa Fe district.—Four producers of ore in the Santa Fe district reported the output of 206 tons, containing $5,151 in gold, 1,600 ounces of silver, 905 pounds of lead, and a little copper, valued in all at $6,796, or $32.99 a ton. The most important operations were at the property of the Luning Consolidated Silver Mines Co., which shipped gold ore 6 miles to Luning and thence to the cyanide plants at Millers.

Silver Star (Marietta and Black Mountain) district.—Five producers in the Silver Star district reported the shipment of 50 tons of

[5] Knopf, Adolph, Ore deposits of Cedar Mountain, Mineral County, Nev.: U. S. Geol. Survey Bull. 725, pp. 361–382, 1921.

[6] Candelaria Mines Co. Ann. Rept. for year ending December 31, 1921. This report contains a paper on the geology of the Candelaria mines by J. A. Burgess.

[7] Knopf, Adolph, The Candelaria silver district, Nev.: U. S. Geol. Survey Bull. 735, pp. 1–22, 1922.

ore, containing principally silver, with a little gold, lead, and copper, valued at $5,307, or $106.14 a ton. The principal lots of ore were shipped from the Silver Bar and Nevada Trimetallic properties.

Walker Lake district.—A little gold bullion was produced from the Hematite claim, 9 miles from Schurz. The ore was reduced at a small milling plant near the property. About 4,000 tons of ore was mined from the Northern Light mine in 1920 and stored at the Mason Valley smelter for treatment when that plant again begins operations.

NYE COUNTY.

Mine production in Nye County, Nev., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	75	429,668	$1,479,579	4,903,987	1,585	633,227	$6,875,875
1921	104	383,064	1,340,178	4,699,710	156	47,275	6,042,036
Increase or decrease, 1921..	+29	−46,604	−139,401	−204,277	−1,419	−585,952	−833,839

[a] Includes placer production.

Barcelona district.—The Spanish Belt mine is developed by an adit 1,400 feet long and laterals and is equipped with a 50-ton combination gravity and flotation-concentration plant. Operations were begun about October 1, 1921, and considerable ore was milled, producing silver concentrate which contained a little gold.

Bellehellen district.—Several lots of silver ore were shipped from the Bellehellen mine and treated at a custom cyanide plant at Tonopah.

Bullfrog district.—The Consolidated Mayflower Mines Co. treated several test lots of ore by amalgamation and shipped gold bullion and a little ore. A lessee operating at the Original Bullfrog mine produced ore of shipping grade containing gold and silver.

Johnnie district.—From the operations of two quartz mines and four placers in the Johnnie district ore and bullion valued at $10,648 were produced. A recovery of $21.19 a ton in gold and silver was made on quartz ore milled. The Eureka Johnnie mine, opened by five shallow shafts and three adits, was worked about four months, and the ore taken out was treated in a two-stamp amalgamation mill. Some gold was recovered from surface material during the season when dry washing was profitable. The Johnnie mine is opened by a shaft 1,000 feet deep and has 10,000 feet of drifts. An 80-ton stamp mill equipped for amalgamation was operated on gold ore and produced considerable bullion.

Mammoth district (Lodi).—Lessees operating the Illinois or Lodi mine shipped one lot of silver-lead ore and milled a little ore taken out in development. The concentrate produced had an average assay of 125.4 ounces of silver and 0.38 ounce of gold to the ton, 9.6 per cent of lead, 6.2 per cent of insoluble, 4 per cent of zinc, 3.6 per cent of speiss, 6.1 per cent of iron, and 0.6 per cent of sulphur. Silver-lead ore was shipped to the smelter from the Quartz Mountain property.

Manhattan district.—Milling ore amounting to 782 tons was produced by 11 operators in the Manhattan district, and placer bullion containing $35,685 in gold and 768 ounces of silver from 26 sources was valued at $36,453. Altogether the district output was $48,961 in gold and 1,049 ounces of silver, valued together at $50,010. The average value of the gold and silver recovered from the ore milled was $17.34 a ton. The largest output from quartz mines came from the April Fool and Union No. 9 properties. Smaller amounts of gold were produced from the Little Grey, Iron King & Iron Queen, Dexter No. 14, and Mustang mines. Ore was hauled from the Union Amalgamated property 45 miles to Tonopah by a lessee. Most of the work in the district was done by lessees.

Morey district.—The Airshaft and Smuggler properties were operated and produced ore of shipping grade, containing principally silver and a little gold and lead.

Philadelphia or Belmont district.—Old tailing from the Belmont milling plant was treated in a 30-ton cyanide leaching plant. About 5,000 tons of this tailing, assaying 3.8 ounces of silver to the ton, remains for future treatment.

Reveille (Arrowhead) district.—Silver ore was produced from the Arrowhead mine and treated in a custom mill at Tonopah. This district is about 4 miles north of the old camp of Reveille, in the Reveille Range. Considerable silver ore was found in mines located in this range between 1866 and 1871, but little prospecting has been done until recently. Silver ore was also shipped to Tonopah from the Cascade group and from the Eureka group of the Southwestern Nevada Mines Co.

Round Mountain district.—Seven producers of ore in the Round Mountain district reported the production of 2,585 tons of ore, containing 7,612.56 ounces of gold and 4,812 ounces of silver, valued together at $162,178, or $62.74 a ton. The output of bullion from placer operations was valued at $120,844. The Fairview Round Mountain, Fairview Extension, and Round Mountain Mining companies were the principal producers. As in the past, most of the placer production was from the Round Mountain property.

At the Round Mountain property [8] the quartz mining operations were in the hands of lessees, who mined and milled in the company's mill 1,936 tons of gold ore having a gross value of $96,628.03, or $49.91 a ton. The tailing contained $2,847.04, or $1.47 a ton. The net value of the bullion recovered was $93,780.99, or $48.44 a ton, representing an extraction of 97.06 per cent. The company report continues as follows:

> The total mining costs, including development work of the lessees, was $81,606.39, or $42.152 per ton, of which $65,010, or $33.58 per ton, was for labor, $8,255.97, or $4.205 per ton, for milling, use of mill, crushing, refining and marketing of bullion, and $8,928.45, or $4.548 per ton, for supplies, compressor, liability insurance and miscellaneous items.
>
> From the above ore the company received in royalties $21,760.63, or $11.24 per ton, and from the milling charge for use of the company mill $1,936, or $1 per ton, making the total revenue received by the company from the lease operations $23,696.63, or $12.24 per ton. * * *
>
> During the year ending December 31, 1921, 110,700 cubic yards of placer gravel were hydraulicked, yielding 9,009.47 ounces of bullion having a value of $120,845.70. The total operating costs were $65,650.46, and the net realization $55,195.24. The

[8] Round Mountain Mining Co. Sixteenth Ann. Rept., for year ending Dec. 31, 1921.

gross value recovered represented $1.0917 per cubic yard, production cost $0.5931 per cubic yard, and realization $0.4986 per cubic yard. * * *

In 1921 the company cleaned 58,000 square feet of bed rock which yielded $13,959.63, or $0.2407 per square foot. The net realization was $0.0955 per square foot.

The final clean-up of the main tail race was made during the months of October and November and totaled $20,880.89. Of this amount $16,289.25 was obtained from the flume clean-up and $4,591.64 was obtained from milling 219 tons of concentrates worth $20.966 per ton. This final clean-up represented 17.3 per cent of the total recovered value.

Lessees operated the Fairview property[9] during 1921, mining and milling 815 tons of gold ore valued at $75,758.43, or $92.95 a ton. The tailing loss was $1.63 a ton. The value of gold and silver in bullion recovered was $74,426.59, or $91.32 a ton, representing an extraction of 98.2 per cent.

A recent bulletin[10] reviews the geology of the district.

San Antone (Royston) district.—One lot of rich silver ore from the Hudson property was shipped to Tonopah for treatment by the cyanidation process.

Silver Bow district.—Bullion and a little concentrate containing gold and silver was shipped from the Blue Horse property prior to closing the mine.

Tonopah district.—The production of the Tonopah district decreased in 1921, as shown below:

Mine production of Tonopah district, Nevada, 1904–1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	19	387,489	$1,056,988	4,816,055	.....	.....	$6,306,486
1921	25	367,909	999,094	4,623,901	.....	.....	5,622,995
Increase or decrease, 1921	+6	−19,580	−57,892	−192,154	.....	.....	−683,491
Total, 1904–1921	.....	6,308,972	29,088,361	132,905,164	12,113	214,523	116,250,065

According to the annual report of the Tonopah Belmont Development Co.[11]

The ore output of the Belmont mine was 121,169.9 wet tons, or 116,970.8 dry tons, less by 14,333 tons than in the year previous. A total of 146,076 tons of rock, ore, and waste was broken in the mine. The 117,183 tons of Belmont ore milled during the year (212.2 tons of which was from ore stocks) had a gross metal content of 14,654.35 ounces of gold and 1,492,958.08 ounces of silver, with a gross value of $1,795,889.85—a per ton metal content of 0.125 ounce of gold and 12.74 ounces of silver, or $15.326 per ton. The average metal content was higher by 0.014 ounce of gold and 1.99 ounces of silver than the average of the ore of the previous year and the per ton value was $1.647 higher.

On Belmont mine ores the direct mining and milling and general costs were $9.529 per ton, an increase of 2.27 per cent as compared with the $9.317 of the year previous. Shipping and marketing costs were $0.278 per ton as compared with $0.254 per ton in the previous year. Tailings losses were $1.246 per ton and metal losses were $0.015 per ton as compared with $1.055 and $0.022 in the year previous. The Tonopah operating profits were $4.215 per ton, or $1.146 per ton higher than in the previous year. The percentage of profit on Belmont mine ores was 27.5 per cent in 1921, as compared with 22.4 per cent in 1920 and with 32.9 per cent in 1919. * * *

[9] Fairview Round Mountain Mines Co. Ann. Rept. for year ending Dec. 31, 1921.
[10] Ferguson, H. G., The Round Mountain district, Nev.: U. S. Geol. Survey Bull. 725, pp. 383-406, 1921.
[11] Tonopah Belmont Development Co. Nineteenth Ann. Rept., for year ending Dec. 31, 1921.

The mill extraction was 93.89 per cent of the gold, 91.41 per cent of the silver, or 91.76 per cent of the money value. The extraction was lower by 0.76 per cent of the gold and by 0.53 per cent of the silver than in the preceding year.

The production of gold was sold at an average price of $20.6557 per fine ounce ($20.6718 per ounce for 18,641.56 ounces of gold in bullion and $19.40 per ounce for 239.693 ounces in slags, low-grade precipitates, and other products). The production of silver was sold at an average price of $0.99923 per fine ounce ($1.00 per ounce for 1,795,240.44 ounces of silver in bullion and $0.9538 per ounce for 30,395.26 ounces of silver in other products). These totals include gold and silver in custom ore treated.

The direct cost of mining 117,183 tons of Belmont ore was $5.296, and the indirect cost $0.626, or a total of $5.92 a ton. The direct milling cost was $3.32 a ton, the indirect cost $0.288, or a total of $3.61 a ton.

From the Tonopah Extension property [12] 84,463 tons of ore was mined and milled, which contained 10.53 ounces of silver and 0.105 ounce of gold to the ton. The total value of the ore was $1,071,379.39, or $12.68 a ton. The tailing contained $0.825 a ton, representing a loss of 6.5 per cent of the value. The recovery was 829,354 ounces of silver and 8,396.31 ounces of gold, valued together at $1,001,759.84. The cost of mining, including development work, was $6.07 a ton, milling cost $3.84, and marketing cost $0.21, or a total of $10.12. With the metal loss in tailing of $0.825 and depreciation, etc., amounting to $0.632 a ton, the total cost was $11.577 a ton. The net realization per ton of ore was $1.11, and the consumption of sodium cyanide per ounce of bullion recovered was 0.1525 pound. No work was done from No. 1 shaft in 1921, but 1,900 tons of ore was mined from No. 2 shaft, after which operations were discontinued. The most productive area was the 1,800-foot level of the Victor shaft, which is to be continued to the 2,125-foot level. A sump was completed below the 1,650-foot level of the McKane shaft. The company report continues as follows:

> A crosscut to the north was then started on this level. At 150 feet from the shaft a watercourse was drilled into, as a result of which the level was flooded. The water rose in the shaft to the 1,540-foot level and flowed through a 6-inch pipe, previously provided for that purpose, to the sump on the Victor 1,680-foot level. From this sump the water is pumped to the surface.
>
> The presence of this amount of water made increased pumping capacity imperative, and accordingly two vertical triplex motor-driven pumps, of 600 gallons per minute capacity each, were ordered. These pumps will be erected on the 1,540-foot level, and will pump direct to surface through a 10-inch column. A pump station, 40 feet square by 22 feet high, has been cut for the pumps, and work is in progress on a 36,000-gallon capacity sump. * * *
>
> In accordance with the previous custom, no calculation of ore in reserve has been made. Experience has shown such calculations to be of little value for ore bodies of the nature of those in your property. It may be said, however, that the mine is in very good operating condition and that the 1,880-foot level promises to be one of the best levels so far developed.

During 1921 work in the Tonopah mine [13] was conducted through the Mizpah, Silver Top, and Sand-Grass shafts, which produced 43,464 tons of ore. This ore was shipped to the company's mill at Millers. The average content of the mine ore shipped was 0.154 ounce of gold and 14.06 ounces of silver to the ton, or a value of $17.25. Profits from the mine amounted to $177,567.90, or $4.08 a ton. In addition to the mine ore produced, 652 tons of dump ore averaging $9.11 a ton was shipped to the mill. A profit of $1,901.50, or $2.92 a

[12] Tonopah Extension Mining Co. Ann. Rept. for year ending Mar. 31, 1922.
[13] Tonopah Mining Co. of Nevada Twentieth Ann. Rept., for year ending Dec. 31, 1921.

ton, was made from the dump ore. The mining cost was $6.89 a ton in 1921, compared with $5.94 in 1920, and the cost of milling the ore was $4.17 a ton, compared with $4.08 in 1920. A recovery of 93.4 per cent of the gold and 90.6 per cent of the silver was made at the mill, where custom ore was also treated.

The Jim Butler mine[14] produced, entirely by lessees, 8,518 dry tons of silver ore, valued at $156,614, or $18.38 a ton. The ore contained 1,306.14 ounces of gold and 129,630.84 ounces of silver. This output came partly from a lease in the western part of the Jim Butler territory to the West End Consolidated Mining Co., which produced 3,916 tons. Lessees in the Wandering Boy mine produced 1,843 tons, in the Stone Cabin mine 2,516 tons, and in the Desert Queen property 243 tons.

The West End Consolidated Mining Co. was the second largest producer of gold and silver in the Tonopah district. The mine and mill were operated nearly all the year in spite of the labor strike, which interrupted work at other mines. Shipments of bullion were valued at about $120,000 a month, and development work was said to have opened considerable new ore. Details are not available, as no printed report was received.

Other mines of the Tonopah district which produced considerable ore in 1921 were the Halifax, MacNamara, Montana Tonopah, Rescue Eula, Tonopah North Star, Cash Boy, Tonopah Midway, and New California.

Tybo district.—One lot of silver-lead ore was shipped to the smelter from the Tybo district.

Union district.—Silver bullion and concentrates containing silver and lead were shipped from the Webster mine. A 10-stamp cyanide plant was operated, in which the ore is crushed in cyanide solution and run over concentration tables.

Willow Creek district.—Experiments were carried on in a new 5-stamp amalgamation and concentration mill on the Gold Springs mine, at Nyala, and a small quantity of gold bullion was shipped.

ORMSBY COUNTY.

Carson River district.—Tests were made by the Carson River Corporation for the recovery of quicksilver and amalgam near the site of the old Eureka mill on Carson River. The amalgam is recovered by hoisting the material from old tailing dumps to a height of 12 feet and running it through sluice boxes. A small output of gold and silver from this source is credited to the Comstock district.

Delaware district.—A small quantity of copper ore containing silver was shipped from the property of the Comstock Extension Mining Co.

PERSHING COUNTY.

Arabia district.—Several lots of oxidized lead ore were shipped from the Jasper group, the Montezuma mine of the Pershing County Mines Co., and the Electric and Last Chance claims. From four producers 164 tons of ore was shipped, containing $754 in gold, 6,746 ounces of silver, and 62,491 pounds of lead, valued in all at $10,312, or $62.88 a ton.

[14] Jim Butler Tonopah Mining Co. Ann. Rept. for year ending Dec. 31, 1921.

Jersey Valley district.—The Rex group of mining claims, about 43 miles south of Battle Mountain, produced 29 sacks of ore containing silver and lead.

Kennedy district.—Silver ore from the Independence Day and Fourth of July claims was shipped to the smelters in 1921.

Loring (Willard) district (Lovelocks).—Gold bullion and crude ore were shipped from the Treasure Hill claim, which is equipped with an amalgamation mill operated by lessees.

Rochester district.—Eleven producers in the Rochester district produced 87,561 tons of milling ore and 67 tons of silver ore of shipping grade. Some tailing and sweepings from the tailing ponds were also shipped. The total product of the district, including the bullion from the operations of one surface mine, consisted of $176,144 in gold, 667,084 ounces of silver, and 351 pounds of copper, valued in all at $843,273. The ore had an average value of $9.61 a ton, and most of it was produced from the property of the Rochester Silver Corporation and the Nevada Packard Co. Both properties are equipped with cyanidation mills. In addition to the ore of the Rochester Silver Corporation, custom ore was received from the Raven and Argentor properties. The Great Western Mines Co., which owns the Lincoln Hill mine, operated a 2-stamp mill and treated ore by amalgamation. The nearest railroad station is Oreana, on the Southern Pacific Railroad, approximately 10 miles from the district. The Nevada Packard mine was operated eight months and treated a large quantity of low-grade silver ore while in the hands of a receiver.

The mill of the Rochester Silver Corporation [15] treated altogether 55,181 tons of ore, from which 7,700.9 ounces of gold and 526,022 ounces of silver were recovered, having a total value of $685,246.05, or $12.42 a ton. This average value represents 0.151 ounce of gold and 11.63 ounces of silver to the ton of ore. The total ore treated included 7,531 tons mined by lessees and 569 tons of custom ore. The total average operating cost, which includes mining the ore, development, haulage, milling, and miscellaneous expenses was $8.94, leaving a net profit of $3.48 a ton. The total amount of dividends paid to stockholders in 1921 was $177,523.95. According to the company's report the mine is approaching exhaustion and more prospecting is recommended by J. A. Burgess, consulting geologist, who says:

> The veins are productive from the surface to the 1,200-foot level, below which there is a marked decrease of silver values and an increase of base sulphides. This gives a range of 700 feet vertically, and 1,200 feet on the dip, for workable ore. No hope is held out of finding commercial ore in any quantity below the 1,200 level.
>
> While on the whole, the mine is approaching exhaustion, and is working on a "hand-to-mouth" basis, with practically no ore reserve developed, still I believe there is a good chance of finding more ore and I am recommending about 2,300 feet of additional development. If this does not open up ore, there will be little hope of further production. Favorable results from this work may prolong the productive period for a year or so.

Rosebud district.—Two small lots of silver ore were shipped by lessees on property in the Rosebud district in 1921.

Seven Troughs district.—Lessees operating at the property of the Seven Troughs Mining Co. and the Monarch mine produced 79

[15] Rochester Silver Corporation Ann. Rept. for year ending Dec. 31, 1921.

tons of ore, containing $3,437 in gold and 735 ounces of silver, valued in all at $4,172, or $52.81 a ton. Part of the output was milled, producing gold and silver bullion.

Sierra (Sunshine and Dun Glen) district.—Ore was shipped from the Mayflower and Chloride properties in 1921. The Chloride property, operated by the Sunshine Mines Co., produced lead-silver ore containing a little gold and copper.

Unionville (Buena Vista) district.—Operations at the Treasury property of the Unionville Mining Co. and at the Arizona mine represented the principal activities in the Unionville district in 1921. The larger part of the output of 3,271 tons of ore was treated in flotation and cyanidation plants and yielded bullion and concentrate containing gold and silver. There was 93 tons of silver ore containing gold and lead shipped directly to the smelter, with 48 tons of silver concentrate. The total output of five properties contained $10,654 in gold, 58,355 ounces of silver, 151 pounds of copper, and 5,410 pounds of lead, valued in all at $69,273, or $21.18 a ton.

STOREY COUNTY.

Mine production in Storey County, Nev., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Total value.
		Short tons.		*Fine ounces.*	
1920	20	58,494	$321,982	324,744	$675,953
1921	17	64,601	324,827	263,931	588,758
Increase or decrease, 1921	−3	+6,107	+2,845	−60,813	−87,195

Comstock district.—Seventeen producers in the Comstock district reported 64,601 tons of ore mined, including 1,773 tons of old tailings treated and 7 tons of silver ore containing gold shipped directly to the smelter. In December the United Comstock Mines Co. nearly completed the building to house the fine-grinding machinery of the 2,500-ton mill on American Flat. This building will contain all the concentrating tables. Structural steel for the cyanide building has been ordered and the mill is expected to be completed in September, 1922.

The Consolidated Virginia mine was the largest producer in the Comstock district. Gold and silver bullion was recovered by cyanidation at the Mexican mill. This mill also handled considerable ore mined from the Ophir property and some from the Comstock Phoenix mine. Ore from the West End mine was treated by amalgamation and bullion recovered in the Fisher custom mill. Bullion containing gold and silver was recovered by cyanidation by the Comstock Leasing Co., operating the Chollar and Potosi mines. The Bowie cyanide plant treated tailings from which gold and silver bullion was recovered. Lessees mined several hundred tons of ore from the property of the Justice Gold & Silver Mining Co., which was treated in the McTigue amalgamation mill at Silver City.

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WASHOE COUNTY.

Leadville district.—Activity continued in the Leadville district through the operations of the Leadville Mines Co., which did development work throughout the year and operated its concentration-flotation mill from May to the end of 1921. Lead concentrate and crude lead ore were shipped. The mine is at Gerlach, on the Western Pacific Railroad.

Peavine district.—A 50-ton concentration mill was operated by the Standard Metals Co., which shipped copper-lead concentrate rich in silver. Small lots of copper ore were shipped from the Nixon Nevada claims.

White Horse district.—Several lessees working on properties in the White Horse district reported a total output of 97 tons of ore, of which 5 tons containing gold and silver was of shipping grade and the remainder was gold ore treated by amalgamation in a custom mill. The ore came from the Springfield-Nevada, Green Hill, Renegade, and No. 2 mines. Other small lots of bullion were reported from individuals who failed to give the origin.

WHITE PINE COUNTY.

Mine production in White Pine County, Nev., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	38	2,597,236	$475,644	140,954	48,372,471	2,123,259	1,314,837	$9,806,182
1921	28	402,335	90,632	54,570	10,297,756	447,167	.....	1,493,736
Decrease, 1921	10	2,194,901	385,012	86,384	38,074,715	1,676,092	1,314,837	8,312,446

[a] Includes placer production.

Cherry Creek district.—Seven producers in the Cherry Creek district reported the output of 561 tons of ore, containing $2,239 in gold, 23,957 ounces of silver, 429 pounds of copper, and 9,829 pounds of lead, valued in all at $26,693, or $47.58 a ton. All this ore was of shipping grade and came principally from the Exchequer mine, which was operated by a lessee. Ore was also shipped from the Black Metal, North Mountain, Oversight, and Independent properties.

Duck Creek district.—Lead ore containing a little silver, was shipped to the smelter from the McGill and Ely properties.

Hunter district.—Several lots of lead ore containing silver were shipped from the Vulcan property by lessees.

Osceola district.—Two operators of quartz mines in the Osceola district treated 113 tons of ore, producing gold bullion which contained a little silver. A 10-stamp amalgamation mill was operated on ore from the American group, and a 2-stamp amalgamation mill treated ore from the Sunrise property, which is 8 miles from the mill.

Robinson district.—The production of the Robinson district decreased greatly in 1921.

Mine production in Robinson district, White Pine County, Nev., 1904–1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	12	2,589,546	$471,510	65,008	48,347,828	136,194	1,314,837	$9,555,766
1921	4	400,810	82,626	16,069	10,282,527	37,809	.....	1,426,843
Decrease, 1921	8	2,188,736	388,884	48,939	38,065,301	98,385	1,314,837	8,128,923
Total, 1904-1921	.....	37,987,070	6,213,219	1,088,246	843,861,697	2,796,244	4,962,652	164,234,722

The Nevada Consolidated mines [16] and concentrator were closed the first week in April, and at the smelting plant only one reverberatory furnace was operated for a short time thereafter. There was 456,590 tons of ore averaging 1.62 per cent of copper produced. With the exception of 6,168 tons of direct smelting ore, averaging 10.78 per cent of copper, all the ore was from open pit mining. From the blister copper produced 9,362,325 pounds of refined copper was reported, compared with 48,311,985 pounds for 1920. The total dividends paid by the company amount to $46,768,616.60, but no dividends were paid in 1921. Excluding depreciation of plant and equipment, but including all taxes and overhead charges, the total operating cost of copper produced in 1921 was 13.5 cents a pound. With the usual credits for gold and silver and miscellaneous earnings, amounting to 1.16 cents, the net copper cost for 1921 was 12.34 cents a pound, as compared with 15.67 cents a pound on similarly calculated costs for the year 1920. The most important feature of the mine's record in 1921 was the development of additional high-grade smelting ore along the margin of the Ruth ore body of concentrating ore. The following account is given in the company's annual report:

Development of the direct smelting ore body on the Ruth 700 level referred to in the 1920 report was continued during the year. This development totaled 2,734 feet of churn drill footage, 3,243 feet of machine drill footage, and 6,264 feet of drifts and raises, and ore has been found along the strike of the porphyry limestone contact for a distance of 950 feet. The secondary enrichment of the pyritic limestone follows the pervious layers believed to have been crushed as a result of postintrusive faults, of which there is ample evidence. Underground churn drilling has proven the existence of this enrichment 45 feet below the 700 level, where the porphyry-lime contact dips westerly at approximately 30° from the horizontal. Fully developed direct smelting ore estimate as of December 31, 1921, is 406,196 tons, averaging 7.27 per cent copper. Of this total there were extracted in prosecuting the work and shipped to smelter, 30,530 tons, of which 6,168 tons were smelted during the first quarter, the balance, 24,362 tons, mined since the shutdown, remaining in smelter storage. The average analysis of the 30,530 tons, averaging 8.01 per cent of copper, was: Gold, 0.0098 ounce; silver, 0.0528 ounce; iron, 14.4 per cent; silica, 49.5 per cent; lime, 0.37 per cent; alumina, 6.9 per cent; sulphur, 15.3 per cent; and moisture, 9.62 per cent.

Three per cent ore was assumed as the lower limit of direct smelting grade whenever it was possible to segregate ores above from those below that copper content. In addition to the direct smelting tonnage extracted in this development, therefore, approximately 11,000 tons of material under 3 per cent copper was shipped to the concentrator bins. The extent of this high-grade deposit has not yet been determined, and development work along the strike of the contact is proving up deeper penetration of the secondary enrichment into the limestone hanging wall. There are also possibilities of similar ore occurrence on contact zones of disseminated porphyry ore and altered limestone in other parts of the property.

[16] Nevada Consolidated Copper Co. Fifteenth Ann. Rept., for year ending Dec. 31, 1921.

Ward (Taylor) district.—Of the 453 tons of ore produced by six mine operators in the Ward district, the largest part (403 tons) was of shipping grade and contained principally lead and silver with some copper and gold. One lot of ore from the Argus mine was treated by cyanidation and produced silver bullion. The largest part of the output of shipping ore came from the Nevada United property, operated by the Ward Leasing Co. Smaller lots were shipped from the Monitor and Silver Eagle claims.

White Pine district.—The 349 tons of ore produced by five operators in the White Pine district was all of shipping grade and contained $249 in gold, 7,316 ounces of silver, 11,753 pounds of copper, and 319,960 pounds of lead, valued in all at $23,479, or $67.28 a ton. The ore is hauled about 36 miles to Kimberly, a station on the Nevada Northern Railway. Most of the output came from the Great Valley, Nevada, Rocco Homestake, and Young Treasure mines.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO.

(MINES REPORT.)

By C. N. Gerry.[1]

PRODUCTION.

SUMMARY.

The value of the mine production of gold, silver, copper, lead, and zinc in Idaho decreased more than 49 per cent in 1921 from 1920. The output of all metals except gold decreased considerably. Dividends for 1921 amounted to $2,323,889, including an estimate for the Hercules mine.

Since 1863 the State has been an important producer of the five metals, and of the total value to the end of 1921 lead represented $339,499,290, silver $182,267,158, gold $133,358,344, copper $22,440,977, and zinc $41,840,604.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	163	1,958,401	$485,590	7,326,794	2,538,396	249,609,976	27,932,326	$31,170,176
1921	225	1,514,447	545,731	6,080,528	1,688,195	198,469,119	33,463	15,776,819
Increase or decrease, 1921	+62	−443,954	+60,141	−1,246,266	−850,201	−51,140,857	−27,898,863	−15,393,357
Total, 1863–1921	.....	.....	133,358,344	252,864,673	130,248,171	6,696,465,238	430,340,370	719,406,673

ORE.

The quantity of ore sold or treated in Idaho decreased nearly 23 per cent in 1921. Most of the output (95 per cent) was lead ore; copper ore represented 1 per cent; siliceous ore, 3 per cent; and zinc ore and copper-lead ore, 1 per cent. The siliceous ore sold or treated averaged per ton as follows: Gold, $5.93; silver, 1.02 ounces; copper and lead, trace. The copper ore averaged $2.52 in gold and 2.32 ounces of silver per ton and contained 5.35 per cent of copper. Most of the siliceous ore was treated by amalgamation or cyanidation, and most of the copper ore was smelted. The averages of the crude ship-

[1] Much work in the preparation of this report, especially in the compilation of tables, was done by B. N. Patchell, of the United States Geological Survey.

ping product are given later. Lead ore as mined averaged 3.5 cents in gold and 3.93 ounces of silver per ton and contained 0.01 per cent of copper and 6.85 per cent of lead. The zinc ore was all of shipping grade. Copper-lead ore as mined averaged 14 cents in gold and 34.78 ounces of silver per ton and contained 0.69 per cent of copper and 0.71 per cent of lead. Most of the lead ore and copper-lead ore was milled; the results are stated in the table on concentrates (p. 404).

GOLD.

The mine production of gold in Idaho in 1921 showed an increase of 12 per cent. The average yearly output in the last 10 years has been more than $1,000,000, but the output has decreased decidedly in the last five years. Boise County had the largest output of gold, and Shoshone County was second, on account of the operations of the dredge at Murray. The lode mines produced $364,131 in gold, and the placers $181,600, of which $151,762 was won by dredges. Many lode mines were idle, but much work was done on placer property preparatory to operations by dredge or hydraulic methods. Of the total gold, 33 per cent came from placers, 52 per cent from dry or siliceous ore, 5 per cent from copper ore, 9 per cent from lead ore, and 1 per cent from copper-lead ore. The production of gold from amalgamation and cyanidation mills increased to 13,685.22 ounces, or nearly 52 per cent of the total. Concentrates of all kinds contained 8 per cent of the total gold, and crude ore shipped to smelters contained 7 per cent of the total. Since 1897 a total of $4,439,560 in gold has been recovered by dredges.

In 1921 only three mines had a gold output of more than $25,000 each—the Gold Hill & Iowa Mines Co., at Quartzburg, the Yukon Gold Co., at Murray, and the Idaho Metals Co., at Mackay.

SILVER.

The mine production of silver in Idaho in 1921 decreased 17 per cent in quantity and nearly 24 per cent in value. The output of Shoshone County decreased 1,400,400 ounces. A separation of the silver according to source shows that the largest part of the total silver yield, or 94 per cent, was from lead ore, 5 per cent from copper-lead ore, and 1 per cent from other sources. Shoshone County produced 82 per cent of the silver. Concentrates contained 75 per cent of the silver, shipping ore nearly 25 per cent, and gold and silver bullion from deep mines and placer bullion less than 1 per cent.

Eight mines in Idaho produced 86 per cent of the total silver in 1921. They were the Bunker Hill, Morning, Hecla, Independence, Hercules, Ramshorn, Caledonia, and Tamarack & Custer mines. Each of these produced more than 200,000 ounces of silver, and three of them produced more than 1,000,000 ounces each.

COPPER.

The mine production of copper in Idaho in 1921 decreased 33 per cent in quantity. The largest decreases were in Custer, Lemhi, and Shoshone counties. The Idaho Metals property (formerly the Empire), near Mackay, Custer County, was the largest producer of copper in the State, and the Ramshorn and Caledonia mines also produced ore containing copper. More than 65 per cent of the total

output was from copper ore, and about 27 per cent was from lead ore. Crude shipping ore of all kinds contained 76 per cent of the copper and concentrates 23 per cent. Copper property in the St. Joe district, Shoshone County, was being developed.

LEAD.

The mine production of lead in Idaho in 1921 decreased 20 per cent in quantity and 55 per cent in value. Shoshone County supplied 95 per cent of the total output, but a good production was made in Blaine, Lemhi, Boundary, and Custer counties. Nearly all the lead (99 per cent) came from lead ore. Concentrates of all kinds produced 83 per cent of the total, and crude ore shipped was the source of 17 per cent.

Eleven mines produced more than 1,000,000 pounds of lead each in 1921, and four of them—the Bunker Hill, Morning, Hecla, and Hercules—produced more than 10,000,000 pounds each.

ZINC.

As it was impossible to ship zinc ore from the Coeur d'Alene region at a profit in 1921, the large zinc producers did development work while waiting for better market conditions. A few lots of zinc ore were shipped from the Frisco mine, but none from the Callahan, Morning, or Success mines. The producers of zinc ore in the Pine Creek region were idle.

Ore and metal produced in Idaho in 1921.

Source of production.	Ore.		Gold.		Silver.	
	Short tons.	Per cent.	Fine ounces.	Per cent.	Fine ounces.	Per cent.
Dry gold ore	47,174	3.11	13,710.44	51.93	5,452	0.09
Dry gold and silver ore	54	.....	39.14	.15	934	.02
Dry silver ore	993	.07	76.96	.29	42,648	.70
Copper ore	10,322	.68	1,258.62	4.77	23,987	.39
Lead ore	1,446,710	95.53	2,467.70	9.35	5,688,577	93.55
Zinc ore	72	.01	.....	.....	.....	.....
Copper-lead ore	9,122	.60	61.97	.23	317,244	5.22
Total deep mines	1,514,447	100.00	17,614.83	66.72	6,078,842	99.97
Total placers	.....	.....	8,784.90	33.28	1,686	.03
Total, deep and placers, 1921	1,514,447	.....	26,399.73	100.00	6,080,528	100.00
Total, deep and placers, 1920	1,958,401	.....	23,490.42	.....	7,326,794	.....
Increase or decrease, 1921	−443,954	.....	+2,909.31	.....	−1,246,266	.....

Source of production.	Copper.		Lead.		Zinc.	
	Pounds.	Per cent.	Pounds.	Per cent.	Pounds.	Per cent.
Dry gold ore	.....	.....	.....	.....	.....	.....
Dry gold and silver ore	88	0.01	1,200	.....	.....	.....
Dry silver ore	6,996	.41	15,742	0.01	.....	.....
Copper ore	1,105,511	65.48	.....	.....	.....	.....
Lead ore	449,883	26.65	198,322,374	99.93	.....	.....
Zinc ore	.....	.....	.....	.....	33,463	100.00
Copper-lead ore	125,717	7.45	129,803	.06	.....	.....
Total deep mines	1,688,195	100.00	198,469,119	100.00	33,463	100.00
Total deep mines, 1920	2,538,396	.....	249,609,976	.....	27,932,326	.....
Decrease, 1921	850,201	.....	51,140,857	.....	27,898,863	.....

Content of dry gold ores sold or treated in Idaho in 1921.

County.	Ore.	Gold.	Silver.	County.	Ore.	Gold.	Silver.
	Short tons.	*Fine ounces.*	*Fine ounces.*		*Short tons.*	*Fine ounces.*	*Fine ounces.*
Boise	43,517	11,870.67	3,871	Shoshone	8	5.33	16
Camas	8	25.00	14	Valley	30	22.08	12
Elmore	76	48.49	104	Washington	8	4.31	1
Idaho	600	522.08	278				
Lemhi	2,893	1,083.28	566		47,174	13,710.44	5,452
Owyhee	34	129.20	590				

Content of dry gold and silver ores sold or treated in Idaho in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Camas	44	24.00	556	88	1,200
Custer	2	1.64	30	.....	.....
Owyhee	8	13.50	348	.....	.....
	54	39.14	934	88	1,200

Content of dry silver ores sold or treated in Idaho in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Blaine	6	.....	179	.....	400
Boise	33	1.64	486	.....	.....
Bonner	153	6.42	8,031	1,304	9,358
Custer	1	6.21	379	20	23
Elmore	36	2.00	1,634	1,200	836
Owyhee	516	59.48	18,207	.....	.....
Shoshone	74	1.21	3,587	2,040	2,220
Washington	174	.....	10,145	2,432	2,905
	993	76.96	42,648	6,996	15,742

Content of copper ores sold or treated in Idaho in 1921.

County.	Ore.	Gold.	Silver.	Copper.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*
Clark	25	.....	21	8,425
Custer	9,997	1,236.05	23,877	1,088,400
Lemhi	300	22.57	89	8,686
	10,322	1,258.62	23,987	1,105,511

Content of lead ores sold or treated in Idaho in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Blaine	40,692	1,139.35	591,750	35,834	4,925,016
Boise	21	2.27	1,190	.....	5,044
Bonner	6	.36	390	.....	984
Boundary	12,174	29.43	28,184	125	1,501,948
Butte	320	.....	882	41	59,419
Camas	32	2.09	903	91	3,891
Custer	4,474	5.81	28,330	1,856	664,277
Lemhi	9,967	190.66	55,630	9,361	2,077,497
Shoshone	1,379,024	1,097.73	4,981,318	402,575	189,084,298
	1,446,710	2,467.70	5,688,577	449,883	198,322,374

MINING INDUSTRY.

As conditions of the mining industry had improved considerably in 1920, a general increase in production was naturally expected in 1921. Early in the year, however, metal prices declined, the market for copper, lead, and zinc was poor, and many of the large producing mines were closed. The value of the metal output of Idaho was consequently about one-half that of 1920, notwithstanding that freight rates on ore and bullion and labor costs were reduced. Had it not been for the high price of silver, an increase in the production of gold, and the continued operation of the Bunker Hill smelting and refining plant at Bradley, the metal output of the State would have further decreased. The industry was reviewed by the State mine inspector,[2] who gave lists of the operators in each county with interesting references to literature on geology and mining in many districts.

METALLURGIC INDUSTRY.

In Idaho 39 milling plants of all kinds were in operation in 1921, against 36 in 1920. Of these mills 22 were concentration plants, 10 of which used flotation machines with other concentrating devices, 3 used flotation alone, and 9 used crushers, jigs, and tables without flotation cells; 12 used amalgamation alone; 3 used cyanidation; 1 used amalgamation and concentration; and 1 used amalgamation, concentration, and cyanidation. A complete list of mills in Idaho giving the process and equipment of each was prepared for 1920, and a copy may be obtained from the Bureau of Mines, Washington, D. C.

More than 3 per cent of the ore was treated in gold and silver mills in 1921. Bullion from this ore treated by amalgamation and cyanidation was valued at $288,918, or $6.12 a ton, an increase in both the quantity of the bullion and the value per ton, though many of the lode mines were idle. Nearly all the gold in bullion was won by amalgamation, and 355 pounds of quicksilver, 11,391 pounds of sodium cyanide, and 600 pounds of potassium cyanide were used at these mills in 1921. The average consumption of quicksilver was 0.0079 pound per ton of ore amalgamated and 0.025 pound per ounce of gold and silver bullion saved. The consumption of cyanide was 4.51 pounds per ton of ore treated and 2.12 pounds per ounce of gold and silver bullion recovered.

Gold and silver produced in mills in Idaho in 1921, by counties.

County.	Ore (short tons.)	Bullion (fine ounces) recovered from ore by—				Total value.
		Amalgamation.		Cyanidation.		
		Gold.	Silver.	Gold.	Silver.	
Boise	43,550	9,723.17	2,299	2,149.14	2,058	$249,780
Custer	2	.....	.....	1.64	30	64
Elmore	71	12.35	28	26.14	20	844
Idaho	600	522.08	278	.....	.....	11,070
Lemhi	2,893	771.28	156	312.00	410	22,959
Owyhee	41	37.20	167	98.50	544	3,516
Shoshone	8	5.33	16	.....	.....	126
Valley	30	22.08	12	.....	.....	469
Washington	8	4.31	1	.....	.....	90
	47,203	11,097.80	2,957	2,587.42	3,062	288,918

[2] Campbell, Stewart, Mining industry of Idaho: Idaho State Mine Inspector Twenty-third Ann. Rept., for the year 1921.

More than 78 per cent of the ore was concentrated. Concentrates from this ore, from 218,935 tons of old tailings treated, and from ore treated in gold and silver mills aggregated 201,652 tons and were valued at $59.91 a ton, against $88.55 in 1920. The concentrates came largely from the Coeur d'Alene region, and the ratio was 6.9 tons of ore and tailings to 1 ton of concentrate. Nearly all the total was lead concentrate, as no lead-zinc ore was treated to save zinc concentrate in 1921. Operators in Shoshone County shipped an average of 15,973 tons of concentrates of various kinds a month, against 22,351 tons in 1920. This with the crude ore shipped, which was 4,357 tons a month, gives the Coeur d'Alene region an average monthly output of 20,330 tons of concentrates and crude ore, against 27,730 tons in 1920. The average metal content of the lead concentrate was about the same as that of 1920, but the average value decreased from $89.53 to $58.66 a ton.

Mine production of metals from Idaho concentrates in 1921.

By counties.

County.	Ore to concentrating mills.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Total value of concentrates.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Blaine	39,185	5,729	961.25	436,795	28,493	3,609,980	$622,791
Boundary	12,090	1,209	9.24	26,735	.....	1,429,562	91,256
Butte	300	50	.....	237	.....	47,100	2,357
Custer	10,166	1,465	4.50	284,855	101,139	615,832	325,708
Elmore	5	1	10.00	56	.....	.....	263
Lemhi	8,990	1,512	110.09	39,758	14,476	1,364,360	105,297
Owyhee	507	7	50.70	15,680	.....	.....	16,728
Shoshone	1,110,968	191,679	907.57	3,764,244	248,962	157,805,673	10,916,376
	1,182,211	201,652	2,053.35	4,568,360	393,070	164,872,507	12,080,776

By kinds of concentrates.

Dry or siliceous	.....	8	60.70	15,736	.....	.....	$16,991
Copper	.....	19	22.56	89	8,686	.....	1,677
Lead	.....	200,859	1,965.59	4,290,163	283,886	164,766,020	11,781,887
Copper-lead	.....	766	4.50	262,372	100,498	106,487	280,221

Average content.

Kind of concentrates.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	
Dry or siliceous	8	7.59	1,967.00	.....	.....	$2,123.87
Copper	19	1.19	4.68	22.86	.....	88.26
Lead	200,859	.01	21.36	.07	41.01	58.66
Copper-lead	766	.01	342.52	6.56	6.95	365.82
	201,652	.01	22.65	.10	40.88	59.91

Of the total ore 4 per cent was shipped crude to smelters, and most of it with the concentrates was treated at East Helena, Mont., Bradley, Idaho, Northport, Wash., and Vallejo, Calif. The total

value of the first-class ore was $3,218,206, a decrease from $6,305,017 in 1920. Nearly 84 per cent of the crude ore shipped was lead ore and 15 per cent was copper ore. The combined value of the concentrates and crude ore shipped was $15,298,982. Most of the ore smelted was sulphide.

Mine production of metals from Idaho crude ore shipped to smelters in 1921.

By counties.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Blaine	1,513	178.10	155,134	7,341	1,315,436	.....	$218,958
Boise	21	2.27	1,190	.....	5,044	.....	1,464
Bonner	159	6.78	8,421	1,304	10,342	.....	9,194
Boundary	84	20.19	1,449	125	72,386	.....	5,140
Butte	20	.....	645	41	12,319	.....	1,204
Camas	84	51.09	1,473	179	5,091	.....	2,781
Clark	25	.....	21	8,425	.....	.....	1,108
Custer	10,408	1,305.53	80,428	1,109,614	169,159	.....	258,168
Elmore	36	2.00	1,634	1,200	836	.....	1,867
Lemhi	1,277	103.13	15,961	3,571	713,137	.....	50,645
Owyhee	10	15.78	2,754	.....	.....	.....	3,080
Shoshone	52,287	191.37	1,220,661	155,653	31,280,845	33,463	2,654,007
Washington	174	.....	10,145	2,432	2,905	.....	10,590
	66,098	1,876.24	1,499,916	1,289,885	33,587,500	33,463	3,218,206

By kinds of ore.

Dry or siliceous	506	80.62	27,279	7,084	16,942	.....	$30,622
Copper	10,022	1,236.05	23,898	1,096,825	.....	.....	190,939
Lead	55,362	502.11	1,398,414	165,997	33,556,354	.....	2,940,243
Zinc	72	.....	.....	.....	.....	33,463	1,673
Copper-lead	136	57.46	50,325	19,979	14,204	.....	54,729

Average content.

Kind of ore.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*	
Dry or siliceous	506	0.16	53.91	0.70	1.67	.....	$60.52
Copper:							
Oxidized	4,930	.12	2.42	5.50	.....	.....	19.13
Sulphide	5,092	.12	2.35	5.44	.....	.....	18.97
Lead:							
Oxidized	7,938	.01	19.93	.42	11.92	.....	32.10
Sulphide	47,424	.01	26.15	.10	33.38	.....	56.62
Zinc:							
Sulphide	72	.....	.....	.....	.....	23.24	23.24
Copper-lead:							
Oxidized	15	.02	134.60	5.52	5.24	.....	154.00
Sulphide	121	.47	390.22	7.57	5.22	.....	433.21
	66,098	.03	22.69	.98	25.40	.02	48.69

PRODUCTION BY COUNTIES.

GENERAL FEATURES.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1921.

County.	Gold.					Silver.	
	Placers.		Deep mines.		Total value.	Fine ounces.	Value.
	Fine ounces.	Value.	Fine ounces.	Value.			
Ada	20.46	$423			$423	8	$8
Bingham	24.04	497			497	2	2
Blaine			1,139.33	$23,552	23,552	591,929	591,929
Boise	513.98	10,625	11,874.57	245,469	256,094	5,678	5,678
Bonner			6.77	140	140	8,421	8,421
Bonneville	110.97	2,294			2,294	4	4
Boundary			29.41	608	608	28,184	28,184
Butte						882	882
Camas	3.00	62	51.08	1,056	1,118	1,473	1,473
Canyon	2.42	50			50		
Clark						21	21
Clearwater	171.59	3,547			3,547	43	43
Custer	71.60	1,480	1,311.68	27,115	28,595	369,876	369,876
Elmore	21.67	448	50.46	1,043	1,491	1,746	1,746
Idaho	448.29	9,267	522.07	10,792	20,059	363	363
Jerome	6.53	135			135		
Latah	25.20	521			521	2	2
Lemhi	86.11	1,780	1,296.54	26,802	28,582	56,293	56,293
Owyhee	7.26	150	202.20	4,180	4,330	19,147	19,147
Power	6.29	130			130	1	1
Shoshone	7,201.97	148,878	1,104.31	22,828	171,706	4,986,263	4,986,263
Twin Falls	8.32	172			172		
Valley	55.20	1,141	22.10	457	1,598	46	46
Washington			4.31	89	89	10,146	10,146
	8,784.90	181,600	17,614.83	364,131	545,731	6,080,528	6,080,528

County.	Copper.		Lead.		Recoverable zinc.		Total value.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
Ada							$431
Bingham							499
Blaine	35,834	$4,623	4,925,416	$221,644			841,748
Boise			5,044	227			261,999
Bonner	1,304	168	10,342	465			9,194
Bonneville							2,298
Boundary	125	16	1,501,948	67,588			96,396
Butte	41	5	59,419	2,674			3,561
Camas	179	23	5,091	229			2,843
Canyon							50
Clark	8,425	1,087					1,108
Clearwater							3,590
Custer	1,215,993	156,863	794,103	35,735			591,069
Elmore	1,200	155	836	37			3,429
Idaho							20,422
Jerome							135
Latah							523
Lemhi	18,047	2,328	2,077,497	93,487			180,690
Owyhee							23,477
Power							131
Shoshone	404,615	52,195	189,086,518	8,508,893	33,463	$1,673	13,720,730
Twin Falls							172
Valley							1,644
Washington	2,432	314	2,905	131			10,680
	1,688,195	217,777	198,469,119	8,931,110	33,463	1,673	15,776,819

Producing placer mines and production of gold and silver in Idaho in 1920 and 1921.

County.	1920						1921					
	Mines.			Gold.	Silver (fine ounces).	Total value.	Mines.			Gold.	Silver (fine ounces).	Total value.
	Hydraulic.	Dredge.	Drift.				Hydraulic.	Dredge.	Drift.			
Ada	1			$70		$70	3			$423	8	$431
Benewah	2			503	2	505						
Bingham							1			497	2	499
Boise	5			1,594	21	1,616	15			10,625	131	10,756
Bonneville	1			346	1	347	4	1		2,294	4	2,298
Camas							1			62		62
Canyon							1			50		50
Clearwater	4	1		7,385	89	7,482	6	1		3,547	43	3,590
Custer	5			1,176	23	1,201	4			1,480	16	1,496
Elmore	1			102	2	104	4			448	8	456
Idaho	15		1	3,609	25	3,637	28		1	9,267	85	9,352
Jerome							1			135		135
Latah	2			297	1	298	4			521	2	523
Lemhi	4			1,414	7	1,422	4			1,780	8	1,788
Owyhee							3			150	2	152
Power							1			130	1	131
Shoshone	2	1		95,775	900	96,756	3	1		148,878	1,342	150,220
Twin Falls	1			54	1	55	2			172		172
Valley	3			1,489	47	1,540	3			1,141	34	1,175
	46	2	1	113,814	1,119	115,033	88	3	1	181,600	1,686	183,286

Ore sold or treated, deep mines producing, and average value of ores in Idaho in 1920 and 1921, by counties.

County.	Ore sold or treated in 1921 (short tons).		Number of deep mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	Total.	Increase or decrease.	1920	1921	1920	1921	1920	1921
Adams		− 71	1		$57.60		$2.39	
Blaine	40,698	+ 19,562	16	20	23.74	$20.68	15.33	$15.12
Boise	43,571	+ 8,046	8	10	7.71	5.77	7.71	5.76
Bonner	159	+ 120	3	4	68.44	57.82	62.21	53.84
Boundary	12,174	− 15,896	1	2	12.40	7.92	2.63	2.36
Butte	320	+ 319	1	4	14.00	11.13	2.00	2.76
Camas	84	+ 21	1	4	31.54	33.11	18.60	30.11
Clark	25	+ 25		1		44.32		.84
Custer	23,596	− 4,609	17	14	30.38	24.99	14.62	16.82
Elmore	112	+ 35	2	6	10.99	26.54	10.99	24.83
Fremont		− 90	1		51.00		1.11	
Gem		− 61	3		132.87		118.79	
Idaho	600	+ 566	2	2	19.76	18.45	19.76	18.45
Lemhi	13,160	− 8,175	15	23	33.00	13.59	8.72	6.31
Owyhee	558	+ 457	6	9	190.36	41.80	189.75	41.80
Shoshone	1,379,178	−443,310	36	31	15.50	9.84	3.83	3.63
Valley	30	+ 30		1		15.63		15.63
Washington	182	− 923	1	2	69.93	58.68	61.75	56.24
	1,514,447	−443,954	114	133	15.86	10.30	4.27	4.25

ADAMS COUNTY.

No ore was shipped from Adams County in 1921, but exploration was continued, especially at the Red Ledge property of the Idaho Copper Co., where a deposit of copper ore is being developed by tunnel and diamond-drill work.

BLAINE COUNTY.

Mine production in Blaine County, Idaho, in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	16	21,136	$13,134	285,245	30,766	2,149,593	.....	$501,679
1921	20	40,698	23,552	591,929	35,834	4,925,416	.....	841,748
Increase, 1921	4	19,562	10,418	306,684	5,068	2,775,823	.....	340,069
Total, 1880-1921	.....	.....	2,528,878	16,953,044	317,829	193,094,597	7,997,090	27,232,888

There was a large increase in the output of Blaine County in 1921, and the value was greater than in any other county but Shoshone. The ore sold or treated averaged $20.68 a ton in total value and $15.12 a ton in gold and silver. Most of the ore was milled and produced concentrates which had an average value of $108.71 a ton. Crude ore shipped had an average value of $144.72 a ton. From 1880 to 1921 Blaine County has produced $2,528,878 in gold, $15,515,524 in silver, $57,428 in copper, $8,482,509 in lead, and $648,549 in zinc.

Mineral Hill district (Hailey).—Ten deep mines in the Mineral Hill district produced 676 tons of ore, containing $206 in gold, 18,068 ounces of silver, 1,957 pounds of copper, and 178,285 pounds of lead, valued in all at $26,550, or $39.28 a ton. The decrease in production was due to the fact that no tailings from the Minnie Moore dump were re-treated. Most of the ore came from the Eureka, Lark, Minnie Moore, and Utah Bellevue properties. The Bunker Hill & Sullivan Mining & Concentrating Co. took a lease and bond on the Bullion & Mayflower property, installed equipment, and continued development.

Warm Springs district (Ketchum).—Ten deep mines in the Warm Springs district produced 40,022 tons of ore, containing $23,346 in gold, 573,861 ounces of silver, 33,877 pounds of copper, and 4,747,131 pounds of lead, valued in all at $815,198, or $20.37 a ton. Most of the ore, or 38,753 tons, was reduced to 5,657 tons of concentrates, and 1,269 tons was first-class lead ore. The largest producer of the district and the county was the Independence mine, owned by the Federal Mining & Smelting Co. The mine and the 125-ton concentrating mill were operated continuously and the output was greatly increased. According to the printed report[3] of the operating company, the mine produced 37,664 tons of ore, most of which was milled. On January 1, 1922, the ore reserves consisted of 28,000 tons of ore, equal to about 3,600 tons of lead concentrate, and 1,800 tons of shipping ore. The ore contains the following minerals characteristic of the district: Galena, tetrahedrite, sphalerite, jamesonite, siderite, and pyrite. The lower tunnel and other expensive developments are now completed, and the property is making satisfactory earnings. The North Star mine, a producer of lead-zinc ore, was idle. The next largest producer in the district was the Golden Glow mine. Lead concentrate was shipped to Midvale, Utah.

[3] Federal Mining & Smelting Co. Ann. Rept. for year ending Dec. 31, 1921.

BOISE COUNTY.

Mine production in Boise County, Idaho, in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	13	35,525	$265,795	8,783	26	1,650	$275,505
1921	25	43,571	256,094	5,678	.....	5,044	261,999
Increase or decrease, 1921	+12	+8,046	−9,701	−3,105	−26	+3,394	−13,506
Total, 1863–1921	.....	.....	53,269,471	2,210,788	.....	.....	.....

[a] Includes placer production.

The output of gold in Boise County decreased nearly 4 per cent in 1921. Ten deep mines produced ore that averaged $5.77 a ton. Nearly all this ore was treated in gold and silver mills, and the bullion was valued at $249,780.

Banner district.—Bullion from the operations of a cyanide plant was shipped from the Edna property.

Boise Basin district (Placerville, Quartzburg, Idaho City).—Nine deep mines and 15 placers in the Boise Basin district produced 43,538 tons of ore, $256,060 in gold, 5,192 ounces of silver, and 5,044 pounds of lead, valued in all at $261,479, or $5.76 a ton. The deep mines produced gold valued at $245,435 and 5,061 ounces of silver, and the placers gold valued at $10,625 and 131 ounces of silver. The only large operator of the district was the Gold Hill & Iowa Mines Co., which produced more gold than any other operator in the State. The property is equipped with a 150-ton amalgamation and concentration mill and a 15-ton cyanidation plant. The mine is opened by a vertical shaft 500 feet deep and 2,000 feet of drifts. Most of the gold is free, but some of it occurs with pyrite and stibnite and requires cyanidation. The largest placers operated in the district were the Crevice Diggings and Gold Eagle properties. There were no dredge operations in 1921, but a dredge is being installed at the Moore Creek Boulder property, and another may be purchased to work the old Centerville property.

BONNER COUNTY.

Lakeview district.—Several lots of ore, containing lead and considerable silver, were shipped from the Lakeview and Conjecture properties.

Pend Oreille district.—Rich silver ore was shipped from the Blue Bird and B. F. H. mines. The Armstead Mines (Inc.), operating the Keystone mine, has opened much silver ore. In August the company began to install a 150-ton flotation plant, and development of the mine was continued by driving a 3-compartment raise 800 feet from the main tunnel level. An article[4] on the mines of the Pend Oreille and Lakeview districts appeared in August.

[4] Northwest Min. Truth, Bonner County number, August 4, 1921.

BONNEVILLE COUNTY.

Mount Pisgah district.—Five placers in the Mount Pisgah district produced gold valued at $2,294 and 4 ounces of silver. A small one-bucket dredge was operated at the Rassmasen property of the Wolverine Co. The production from the American placer was unusually small, but in October machinery was hauled in to work the property of the Caribou Placer Mines Co.

BOUNDARY COUNTY.

Moyie Yahk district.—The mines of the Moyie Yahk district marketed no bullion in 1921, but the Cyanide Gold Mining Co. installed a 50-ton milling plant, and the Idaho Gold & Ruby Co. constructed a flume and made other preparations for extensive hydraulic operations. Concentration tables will be used to treat the sand.

Port Hill district (Klockmann).—The Idaho Continental Co. did not operate its mill during 1921, but more than 1,000 tons of concentrate from previous operations was shipped to the Bunker Hill smelter at Bradley.

BUTTE COUNTY.

Antelope district.—The Needle Mining & Milling Co. produced one shipment of lead ore from the Lead Belt mine.

Dome district.—The Wilbert mine, near Arco, was idle during 1921, but a shipment of lead concentrate was cleaned up from around the mill, which was destroyed by fire in 1918. Early in 1922 the old shaft was abandoned and a new working and drain tunnel was begun.

CAMAS COUNTY.

Beaver Creek or Camas district.—A little gold and silver ore came from the Princess Blue Ribbon mine, 11 miles from Blaine.

Little Smoky district.—The Climax, Horn Silver, and Red Horse properties, north of Fairfield, made several small shipments of ore. The Axalotl Mining Co. was developing placer claims preparatory to operating throughout the season, which lasts only about four months. A new concentration plant was erected for the Five Points mine by the Walton Mines Co., a producer of silver-lead ore.

CLARK COUNTY.

One lot of oxidized copper ore was shipped from the Paymaster mine, owned by the Skull Canyon Mining Co.

CLEARWATER COUNTY.

Moose Creek district.—Placer gold was mined at the Independence and Alma claims, near Moose City.

Pierce district.—Five placers in the Pierce district produced $3,413 in gold and 42 ounces of silver, which was less than half the production of 1920. Most of the output came from the operations of the Bailey dredge on Oro Fino Creek. Other producers were the Hay Creek and Mox Mox placers. A new amalgamation plant was erected at the Bloyer mine.

CUSTER COUNTY.

The output of Custer County was valued at $591,069, a decrease of $266,961. Several of the producing districts are more than 100 miles from Mackay, the principal shipping point.

Alder Creek district (Mackay).—Four deep mines in the Alder Creek district produced 10,234 tons of ore, containing $25,648 in gold, 27,724 ounces of silver, 1,088,524 pounds of copper, and 124,649 pounds of lead, valued in all at $199,401, or $19.48 a ton. All the output was first-class shipping ore. The largest part of the production was copper ore from the White Knob mine, operated by the Empire Copper Co. until October, when the property was reorganized under the name of the Idaho Metals Co. The ore is shipped to Garfield, Utah, and is a mixture of oxidized and sulphide minerals. Lead ore was shipped from the Doughboy, Homestake, and Horseshoe properties, but the output was small compared with past years.

Bayhorse district (Clayton).—Six deep mines in the Bayhorse district produced 13,342 tons of ore, containing $121 in gold, 336,960 ounces of silver, 126,275 pounds of copper, and 661,145 pounds of lead, valued in all at $383,122, or $28.72 a ton. The largest producer was the Ramshorn Mines Co., which treated considerable ore and old tailings and shipped concentrate and crude ore rich in silver. The mine is opened by an adit 3,000 feet long, and the output is shipped 67 miles to Mackay, Idaho. Considerable lead ore from the Red Bird mine was milled in a 50-ton plant by the Idaho Mine Development Co. Smaller producers were the Skylark, Cave, Good Friend, and Turtle properties.

Sea Foam district.—A small quantity of rich silver-lead ore was shipped from the Ella B. property.

Stanley Basin district.—The Congress and Hohmann placers were operated a short time

Yankee Fork district.—The Whynot mine produced one lot of copper-lead ore exceptionally rich in gold and silver. The property is opened by an adit 600 feet long. A test shipment of rich gold and silver ore was made from the Buster mine. Placer gold was produced as usual from the Rough Creek property.

ELMORE COUNTY.

Bear Creek district.—The Major property, near Featherville, produced a little gold and silver bullion from the operations of an amalgamation mill. Only a little placer gold was produced, but it is probable that there will be a large production from this source in the future, as the South Park Dredging Co. was installing a bucket dredge at Featherville. A line was being constructed to transmit electric power from Mountain Home. The Idaho Gold Corporation was formed in November to operate the Vishnu and other claims at Rocky Bar.

Middle Boise district.—The mines of the Middle Boise district were practically idle during 1921, but several test lots of bullion and concentrate were shipped. The Atlanta, General Pettit, Minerva, and Big Lode mines were formerly large producers of gold and silver.

Pine Grove district.—One lot of rich silver ore was shipped from the World's Fair mine, near Mountain Home.

Twin Springs district.—A small quantity of placer gold was won from the gravel of the Last Chance claim.

Volcano district.—The Blackstone property, near Hill City, was operated under lease and produced one lot of silver ore.

IDAHO COUNTY.

Gold and silver produced in Idaho County was valued at $20,422, an increase from $4,309 in 1920, resulting from activity at Warren.

Camp Howard district.—A small quantity of placer gold was produced from the Cape Horn mine, near Whitebird.

Clearwater district.—The Cove Placers and several small placer operators in the Clearwater district, near Grangeville, produced $585 in gold and 6 ounces of silver.

Elk City district.—Six placer properties in the Elk City district produced $1,072 in gold and 13 ounces of silver. The Relief placer was the largest producer.

Marshall Lake district (Burgdorf).—The Holte Mining Co. was idle most of the year, but gold bullion from previous operations was shipped early in 1921.

Newsome district.—Placer gold was shipped from hydraulic operations of the Moose Creek Gold Mining Co., near Newsome.

Simpson district.—Four placers in the Simpson district produced $494 in gold and 6 ounces of silver.

Tenmile district.—The Crescent, Little Leggett, and Tippie properties produced $1,241 in gold and 9 ounces of silver from placer operations.

Warren district.—Nine placers and one deep mine in the Warren district produced $12,605 in gold and 250 ounces of silver, valued together at $12,855. The United Mines Co., owning the Little Giant mine, produced considerable gold by amalgamation and constructed a new hydroelectric power plant during the year. The largest placer operations were carried on at the Golden Rule mine on Grouse Creek, 6 miles from Burgdorf. A summary[5] of conditions in the Warren district was published in August.

JEROME COUNTY.

A small quantity of placer gold was produced from the banks of Snake River near Jerome.

LATAH COUNTY.

Hoodoo district.—The Annie, Liberty, and Hard Work placers produced $494 in gold and 2 ounces of silver.

LEMHI COUNTY.

Mine production in Lemhi County, Idaho, in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1920	19	21,335	$32,754	142,010	260,139	5,876,375	$705,521
1921	27	13,160	28,582	56,293	18,047	2,077,497	180,690
Increase or decrease, 1921..	+8	−8,175	−4,172	−85,717	−242,092	−3,798,878	−524,831

[a] Includes placer production.

[5] Pointon, B. S., Warren mining district; Northwest Min. Truth, Aug. 19, 1921, p. 3.

The value of the metal output of Lemhi County decreased 74 per cent on account of the curtailment at Gilmore. The output of 23 deep mines was valued at $178,902, or $13.59 a ton. The placer output was valued at $1,788. Most of the ore, or 8,990 tons, was concentrated and reduced to 1,512 tons of concentrates, which had an average value of $69.64 a ton.

Blackbird district.—Several hundred tons of gold ore from the Musgrove property was treated by cyanidation.

Eldorado district (*Salmon*).—No copper ore was shipped from the Eldorado district, but the mill of the Harmony Mines Co. was improved to make a better saving. Construction work was continued at the Pope Shenon mill, and an article on the process appeared in August.[6]

Indian Creek district (*Ulysses*).—The Ulysses mine, operated by the Buchanan Gold Mining & Leasing Co., produced considerable gold and silver by amalgamation.

Junction district.—Test lots of lead ore were shipped from the Buckhorn and Digmore properties. The Sunset mine, formerly a large producer, was idle.

Mackinaw district (*Leesburg*).—Three placers and one deep mine in the Mackinaw district produced gold valued at $2,890 and 18 ounces of silver. Most of the placer output was that of the Hockensmith property, on Arnett Creek. The Italian mine was operated three months and produced gold and silver bullion in a 30-stamp amalgamation mill. Ore was treated by cyanidation at the Gold Dust property, but no bullion or precipitates were marketed.

McDevitt district.—Several hundred tons of copper ore from the Copper Queen mine, at Tendoy, was treated in a small concentration plant.

Mineral Hill district.—The Pine Creek, Clipper Bullion, and small prospects at Shoup produced $407 in gold and 8 ounces of silver by amalgamation.

Pratt Creek district.—The Goldstone group was operated under lease and produced bullion by amalgamation.

Spring Mountain district.—Four deep mines in the Spring Mountain district produced 418 tons of ore, containing $167 in gold, 1,427 ounces of silver, 446 pounds of copper, and 90,082 pounds of lead, valued in all at $5,705, or $13.65 a ton. Most of the ore came from the Winnie and Iron Mask properties and was treated in the concentration plant of the Idaho Minerals Co.

Texas district (*Gilmore*).—Six deep mines in the Texas district produced 9,473 tons of ore, containing $3,766 in gold, 53,152 ounces of silver, 8,843 pounds of copper, and 1,942,083 pounds of lead, valued in all at $145,453, or $15.35 a ton. Most of the ore output, or 8,292 tons, was concentrated and reduced to 1,407 tons of concentrates. The remainder, 1,181 tons, was shipped directly to smelters. The largest production of both silver and lead came from the Pittsburg-Idaho property, on which a 40-ton concentration mill was active. Other producers were the Latest Out, Gilmore, Alex Stevens, Ridgeway Park, and Mountain Boy properties. The Latest Out mine is

[6] Bradford, R. H., The volatilization process at the Pope Shenon mine: Min. and Sci. Press, vol. 123, p. 263, Aug. 20, 1921.

opened by an inclined shaft 740 feet deep and 20,000 feet of drifts. Oxidized lead ore was shipped to Midvale, Utah. The production was comparatively small in 1921, as the company was repairing damage done by fire in 1920.

Reno (unorganized district).—One lot of oxidized lead ore was shipped from the Cabin mine, near Reno.

OWYHEE COUNTY.

The gold and silver produced in Owyhee County in 1921 was valued at $23,477, an increase from $19,165 in 1920. From 1863 to 1921 the county produced gold valued at $21,663,198 and 24,473,085 ounces of silver, or a total value of $40,541,767.

Carson district (Silver City).—Eight deep mines and one placer in the Carson district produced 508 tons of ore, $4,178 in gold, and 17,502 ounces of silver, valued in all at $21,680, or $42.64 a ton. The largest producer in the district was the Florida Mountain property, near Silver City, where the ore was treated by concentration, and the product, an unusually rich silver concentrate, was hauled 25 miles to Murphy, Idaho. Small lots of ore were also treated from the Delamar, Jap, Pauper, Village Blacksmith, Ophir, and Liberty Bell mines.

Flint district.—Silver ore from the Flint mines was tested in the mill of the Demming Mines Co., and a small quantity of rich concentrates was shipped to Murray, Utah.

Steele district.—The Meadow Creek placer, near Triangle, produced a small amount of gold.

POWER COUNTY.

Snake River district.—The Diamond & Dredge property, 5 miles east of Aberdeen, was operated a few weeks and shipped placer bullion to Denver.

SHOSHONE COUNTY.

Mine production in Shoshone County, Idaho, in 1920 and 1921.

Year.	Number of producers.		Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value
	Deep mines.	Placers.	*Short tons.*		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	36	3	1,822,488	$121,900	6,386,663	571,119	236,210,301	27,932,326	$28,347,791
1921	31	4	1,379,178	171,706	4,986,263	404,615	189,086,518	33,463	13,720,730
Increase or decrease, 1921	−5	+1	−443,310	+49,806	−1,400,400	−166,504	−47,123,783	−27,898,863	−14,627,061
Total, 1884–1921	....	....	.....	6,327,037	189,739,107	73,211,340	[b] 3,083,165	422,272,773	501,020,568

[a] Includes placer production of $148,878 in gold and 1,342 ounces of silver in 1921.
[b] Short tons.

Shoshone County comprises the Coeur d'Alene region, the most productive mining center in Idaho. It includes several mining districts, and the production of these is given separately. The value of the metal output was less than half that of 1920, and the decrease in silver, lead, and zinc was unusually large. The average value of the ore from deep mines in 1921 was $9.84 a ton, and the value in gold and silver was $3.63 a ton. The kinds of ore (nearly all lead ore in 1921) and the contents of each kind have been given in the preceding tables. Most of the ore was milled and yielded lead concentrates valued at $56.95 a ton. Twelve milling plants, having a combined daily capacity of approximately 5,625 tons, were active during the year. These mills were concentration plants, and 11 of them had flotation equipment.

Beaver district.—Three placers in the Beaver district produced $503 in gold and 3 ounces of silver. The Callahan Zinc-Lead Co., a large producer of both lead and zinc in recent years, made no shipments of any kind in 1921. Extracts from the company's report [7] follow:

> Shipments were suspended on October 21, 1920, due to low metal prices. Conditions continued practically unchanged during the year just ended, with average market prices for zinc and lead considerably below the 10-year pre-war average, while at the same time operating costs, though lower than in 1920, were still materially higher than those prevailing during the pre-war period. * * *
>
> Operations in the mine have consisted of sinking the main three-compartment shaft an additional 200 feet, from the No. 10 to the No. 11 level, cutting a total of 1,200 feet of lateral openings, 120 feet of raises, and 1,000 feet of diamond drilling. * * *
>
> On the No. 10 level a raise was driven on the ore for a height of 120 feet. A crosscut was then driven to the foot wall from the top of this raise, exposing a good grade of milling ore for a width of 20 feet. We will extend this raise on through to the No. 9 level above when stoping is resumed.

The principal ore minerals are sphalerite, galena, chalcopyrite, and pyrite.

Coeur d'Alene district.—The Yukon Gold Co., which owns a large floating dredge on Prichard Creek, near Murray, operated throughout the year and handled 1,540,466 cubic yards of gravel at a profit of $59,134. The output was considerably larger than it was in 1920, when the dredge was idle for a time on account of sinking. The report [8] of the company continues:

> One dredge, on the property of the Coeur d'Alene Mining Co., Prichard Creek, yielded $149,821, an average value of 9.726 cents per cubic yard. The cost, excluding depreciation, was $90,686, or 5.887 cents per cubic yard.

Evolution district.—Seven deep mines in the Evolution district produced 1,661 tons of ore, containing $81 in gold, 86,361 ounces of silver, 10,526 pounds of copper, and 785,671 pounds of lead, valued in all at $123,155, or $74.15 a ton. The largest producer was the Western Union mine, operated under lease. Nearly 1,000 tons of rich silver-lead ore was shipped to East Helena, Mont., and Bradley, Idaho. The mine was operated continuously, and it was reported that a large body of galena had been opened. Small lots of silver ore were produced from the Polaris, Mineral Point, and Nellie mines. The Yankee Boy mine, operated by the Sunshine Mining Co., shipped considerable lead ore rich in silver and completed the construction of a new 40-ton concentration-flotation mill. Late in the year the

[7] Callahan Zinc-Lead Co. Ninth Ann. Rept., for year ending Dec. 31, 1921.
[8] Yukon Gold Co. Ann. Rept. for year ending Dec. 31, 1921.

capacity of the plant was increased by the addition of larger rolls and a new ball mill. Prominent minerals of the district are galena, tetrahedrite, and siderite.

Hunter district (*Mullan*).—The Morning mine of the Federal Mining & Smelting Co. was operated throughout the year and shipped ore and concentrate to the smelter at East Helena, Mont. During the year the shaft was sunk from the 1,250 to the 1,450-foot level, a depth of 3,107 feet below the surface. The property is one of the largest silver-lead producers in the State and one of the few dividend payers in 1921. According to the statement to the county assessor, 355,773 tons of ore was mined, which had a gross value of $2,970,313. The net profit was $299,651. Dividends declared by the Federal Mining & Smelting Co. from all properties amounted to $570,000. According to the printed report[9] developed ore reserves in the Morning mine consisted of 863,000 tons of milling ore, equal to about 62,800 tons of lead concentrate and 58,600 tons of zinc concentrate, and 70,900 tons of first-class lead ore. Developments in the lower levels have been gratifying.

Lead ore and concentrate were shipped from the Gold Hunter mine to the Bunker Hill smelter in 1921. The output was comparatively small, as the mine was idle most of the year. Lead ore rich in silver was mined and shipped by lessees. The mine is opened by a 4,200-foot crosscut tunnel, a 1,200-foot shaft, and 35,000 feet of drifts and crosscuts. The Star mine, controlled by the Hecla and Bunker Hill companies, has a large deposit of lead-zinc ore which will be opened at depth by driving an 8,000-foot tunnel from the 2,000-foot level of the Hecla mine. An electrolytic plant has been planned by the Bunker Hill Co. to save the zinc. The most conspicuous minerals of the operating mines were galena, sphalerite, tetrahedrite, siderite, pyrite, and barite.

Lelande district (*Burke, Mace, Frisco*).—Five deep mines in the Lelande district produced 304,293 tons of ore, containing $5,354 in gold, 1,558,662 ounces of silver, 124,200 pounds of copper, 53,071,808 pounds of lead, and 33,463 pounds of recoverable zinc, valued in all at $3,969,942, or $13.05 a ton. Most of the ore, 286,373 tons, was reduced to 39,301 tons of concentrates, and 17,820 tons of ore and 100 tons of old tailings was shipped to the smelter without previous treatment. As the Hercules mine was idle the greater part of 1921, the output of the district was less than half that of 1920. For three months the Hercules mine produced about 25,000 tons of ore a month, most of which was milled at Wallace. The resulting concentrates were shipped to Northport, Wash., for smelting. After March only development work was done, but details of the work are not published. The mine is opened at depth by the Hummingbird tunnel, 8,000 feet long, and a three-compartment shaft. Since 1901 it has produced nearly 27,000,000 ounces of silver and about 661,000,000 pounds of lead, as well as zinc, copper, and gold.

The Hecla mine was operated throughout the year and shipped crude ore and concentrate to the Bunker Hill smelter. According to the statement to the county assessor, 267,825 tons of ore was mined, which had a gross value of $2,606,120. The net profit was

[9] Federal Mining & Smelting Co. Ann. Rept. for year ending Dec. 31, 1921.

$655,530, and dividends amounted to $500,000 in 1921 and $9,005,000 to date. The following notes are taken from the printed report.[10]

Development work, principally in drifts and crosscuts, totaled 3,568 feet.

We are having encouraging results from development work recently started on the Wide West claim, one of the group of claims purchased from the Federal Mining & Smelting Co. in settlement of litigation with that company and the Marsh Mines Consolidated over possession of our east ore body. At a shallow depth, about 100 feet, we have crosscut a vein having a width of from 6 inches to 2 feet, which has at this date been drifted upon about 75 feet. Sixty feet of that distance is in commercial ore, and the face of the drift at this time contains about 15 inches of clean ore. * * *

The Star property in the Hunter district will be owned and operated by the Sullivan Mining Co., in which company the Hecla Co. and the Bunker Hill Co. will have an equal interest. The development will be from Hecla openings and a crosscut is now being driven from Hecla 2,000-foot level to undercut the Star vein. * * * We should reach the Star vein in from two to two and one-half years.

Of the ore mined, 220,051 tons was milled, making 26,794 tons of concentrate. This, with 13,180 tons of crude ore, was smelted and contained 1,060,139 ounces of silver and 39,137,894 pounds of lead.

The production of the Hecla mine for 18 years was 489,300 tons of crude ore and concentrate, containing 13,994,452 ounces of silver, 486,733,665 pounds of lead, and 941,229 pounds of gross zinc. An article[11] on the development of the mine appeared in August.

Lessees operated the mines at Frisco and Mace owned by the Federal Mining & Smelting Co. and shipped 1,969 tons of ore, valued at $115,070, according to the statement given the assessor.

The Marsh Mining Co. began to prospect the east extension of the Russel vein after the settlement of the suit with the Federal Co.

Placer Center district (*Sunset*).—Four deep mines in the Placer Center district produced 37,217 tons of ore, containing $1,013 in gold, 211,396 ounces of silver, 29,400 pounds of copper, and 7,407,729 pounds of lead, valued in all at $549,549, or $14.77 a ton. Of the district output, 2,756 tons was crude ore and 7,400 tons was concentrates. Shipments came from the Tamarack & Custer, Rex, Sister, and Success mines. The largest production was that of the Tamarack & Custer Consolidated Mining Co., which operated the mine and mill for three months and shipped silver-lead ore and concentrate to Northport, Wash. Development work was continued, and much lead ore was said to have been opened on the Puritan level and 200 feet below. The Sister mine was operated by the Sisters Leasing Co., and several hundred tons of silver-lead ore was shipped to East Helena, Mont., and Bradley, Idaho. A little development work was being done in the Rex mine for about 10 months of the year. Early in 1922 the Red Monarch property, in the Beaver district, was acquired by the Rex Co., which plans to open the Rex at depth by continuing the Red Monarch tunnel. The Success mine, a large producer of zinc in the past, was practically idle, though lessees worked in the upper levels. The Galena Mining Co. developed the Chicago-Boston and Killbuck properties and in December reported opening 4 feet of lead ore.

St. Joe district.—The Montana Idaho Copper Co. continued the work of extending its 7,000-foot tunnel to open copper ore at depth. The Richmond mine was idle.

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[10] Hecla Mining Co. Ann. Rept. for year ending Dec. 31, 1921.
[11] Conditions in Hecla: Northwest Min. Truth, Aug. 19, 1921.

Summit district (*Murray*).—Four deep mines in the Summit district produced 339 tons of ore, containing $117 in gold, 539 ounces of silver, and 77,590 pounds of lead, valued in all at $4,147, or $12.23 a ton. The Monarch mine was operated by the Fidelity Co. (Ltd.), and several hundred tons of lead ore was milled. One small shipment of lead ore was made from the Terrible Edith mine, near Murray. Development proceeded at the Paragon, Giant Ledge, and Cedar Creek mines.

Yreka district (*Kellogg*).—Nine deep mines in the Yreka district produced 703,568 tons of ore, containing $10,247 in gold, 1,866,684 ounces of silver, 193,699 pounds of copper, and 80,036,548 pounds of lead, valued in all at $5,503,563, or $7.82 a ton. Most of the ore, or 476,158 tons, together with 215,815 tons of old tailings, was concentrated and reduced to 102,083 tons of concentrates. Crude ore shipped aggregated 11,595 tons. The Yreka district had the most valuable output of the State and was the largest producer of both silver and lead. Though the output of silver and lead increased somewhat, the value of the total output decreased $2,643,230. The Bunker Hill & Sullivan Mining & Concentrating Co. was active throughout the year and retained its lead as the largest producer of silver and lead in the State. Other large producers in the district were the Mullan Milling Co., the Hayes Co., Sierra Nevada, Big Creek, Caledonia, Sidney, and Stewart mines. At the Big Creek property a concentration-flotation mill was active, and lead concentrates were shipped to several smelting plants. The Caledonia mine was operated throughout the year and paid dividends amounting to $26,500. According to the annual statement,[12] 9,102 tons of ore was mined, which had a gross value of $259,012. The production was 201,672 ounces of silver, 4,757 pounds of copper, and 1,303,104 pounds of lead. The report continues:

> Production during this period has come from the completed extraction of the standing ore remaining in the mine, and from the reclaiming of material in stope fillings and dumps left from the early operations of the property, and from which a fair profit has been won because of the good price received for silver and the favorable arrangements for marketing this material at the local smelter. The development work still under way has disclosed no new ore.

The Mullan Milling Co. operated a flotation mill on old tailings and shipped a large quantity of lead concentrate. This company was one of the dividend payers in 1921. The Sidney Leasing Co. operated the Sidney mine from May until October and shipped several hundred tons of carbonate lead ore. The Sierra Nevada property, opened by an adit 4,500 feet long and drifts 1,800 feet in length, was worked continuously and shipped both crude ore and concentrate to the Bunker Hill smelter. The report to the assessor gave 12,909 tons of ore mined, which had a gross value of $241,236. The Hayes Co. operated a 100-ton flotation mill on tailings recovered from Coeur d'Alene River. The project was commercially successful, as indicated by the payment of dividends.

According to the statement to the county assessor, the Bunker Hill & Sullivan Mining & Concentrating Co. mined 426,530 tons of ore, which had a gross value of $4,612,444. The net profit was $676,263

[12] Caledonia Mining Co. Ann. Rept. for year ending Dec. 31, 1921.

and dividends aggregated $981,000. Extracts from the printed report[13] follow:

Improvement in the labor supply made possible a production greater than any annual production since 1917, but the decline in lead price caused a greatly lessened financial return. * * *

Development work in the mine was carried on systematically throughout the year, and sinking of the shaft to the No. 16 level, 1,400 feet below the Kellogg tunnel, was completed, with crosscutting to the ore bodies well advanced. Structural conditions at this level are found to be normal, and a very substantial amount of ore has been disclosed.

New mining ventures during the year consisted of operations at the Idaho-Continental mine, Boundary County, Mayflower-Bullion mine, Blaine County, and the Star mine, Shoshone County, all in Idaho; and of the Mayo operation in Yukon Territory, and Nixon Fork operation in the Territory of Alaska. * * *

We have ore blocked out to date: 24,155 tons in the Stemwinder mine, 102,277 tons in the Sullivan mine, and 4,100,576 tons in the Bunker Hill mine. * * *

The mine was in operation for the full period of twelve months and produced 426,530 tons of concentrating ore at a cost of $1,364,669. * * *

Thirty-four hundred seventy-one (3,471) feet of shafts, drifts, and crosscuts were driven at a cost of $58,333. * * *

The West mill concentrators were in operation the full year, during which 11 9/24 days were lost. * * *

During the year 438,526 tons of mine ore were concentrated, making the average work of the concentrators 1,201 tons per day, or, say, 1,240 tons per 24 hours of actual operation, at a cost of $348,214. * * *

The Sweeney mill was operated on tailings during the year, treating 153,820 tons at a total cost of $79,844.98; 8,064.93 tons of concentrates were produced.

The ore milled, 426,530 tons, contained 3.66 ounces of silver to the ton and 9.86 per cent of lead. From this ore 81,858 tons of concentrates and middlings was produced, containing 72,360,510 pounds of lead and 1,199,989 ounces of silver. In addition concentrates from the Sweeney mill contained 47,658 ounces of silver and 2,016,998 pounds of lead. The total cost per pound of lead was 5.01 cents. From 1886 to 1921 the company has mined 9,506,127 tons of ore, having a gross value of $102,963,070. Net smelter returns were $61,041,732, and operating profit was $34,358,568. An interesting series of articles by Rickard,[14] continued through 1920, gave the history of the Bunker Hill mine, a discussion of the geology of the property, methods of mining, and the milling practice at the different plants. The East mill, destroyed by fire, was being rebuilt in 1921.

The Bunker Hill smelter has been fully described by Rickard.[15] The plant has four blast furnaces, but only one was operated most of the year. In October two furnaces were in blast, treating 600 tons of lead ore a day. The capacity of the refinery was increased to 400 tons a day.

At the Alhambra mine the force was engaged in developing new ore and increasing the capacity of the mill to 100 tons a day. The Lookout Mountain Mining & Milling Co., operating in the Pine Creek section, opened much silver-lead ore in a crosscut at a depth of 300 feet.

In the eastern part of the Yreka district tetrahedrite is prominent at the Big Creek mine. The Bunker Hill property has lead minerals with very little sphalerite associated, but the mines of the Pine Creek section have an abundance of sphalerite.

[13] Bunker Hill & Sullivan Mining & Concentrating Co. Thirty-fourth Ann. Rept., for year ending Dec. 31, 1921.

[14] Rickard, T. A., The Bunker Hill enterprise: Min. and Sci. Press, vol. 120, pp. 5, 41, 109, 185, 261, 337, 485, 521, 703, 791; vol. 121, pp. 195, 335.

[15] Rickard, T. A., The Bunker Hill smelter: Min. and Sci. Press, vol. 122, p. 43, Jan. 8, 1921.

TWIN FALLS COUNTY.

Snake River district.—Sluicing and hydraulic operations at the Klondyke and Ether properties resulted in the shipment of a small quantity of placer gold.

VALLEY COUNTY.

Deadwood Basin district.—A small lot of gold ore was milled at the Merry Blue & Union property.

Thunder Mountain district.—Gold bullion was shipped to the Denver mint from placer operations at the old Dewey property, on Mule Creek.

WASHINGTON COUNTY.

Heath district.—The Last Chance property was under development and produced some gold in testing the ore. The mine is said to contain considerable free milling gold ore.

Washington district.—Several lots of silver ore were shipped from the Egan mine, operated by the B. W. F. Mining Co.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON.

(MINES REPORT.)

By C. N. Gerry.[1]

PRODUCTION.

SUMMARY.

The value of the mine production of gold, silver, copper, lead, and zinc in Washington in 1921 was about 72 per cent less than in 1920. The output of gold and zinc was slightly greater, but that of silver, copper, and lead was much less. Metal mining was practically at a standstill in the chief districts, the value of the output was less than in any year since 1894, and no dividends were paid.

ORE.

The quantity of ore sold or treated in Washington decreased more than 73 per cent in 1921 as a result of curtailment in Snohomish and Stevens counties. The average value per ton of the ore increased from $14.06 in 1920 to $14.38 in 1921, and the value per ton in gold and silver increased from $3.95 to $11.70. Of the total output of ore in 1921 nearly 70 per cent was gold ore, whereas in 1920 about 74 per cent was copper ore.

The total and average content of both crude ore and concentrates shipped are given on pages 424 and 425.

Mine production of gold, silver, copper, lead, and zinc in Washington in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	44	85,318	$120,860	199,678	1,983,134	5,787,247	426,496	$1,200,932
1921	37	22,885	128,486	142,450	251,544	143,553	449,360	332,313
Increase or decrease, 1921	−7	−62,433	+7,626	−57,228	−1,731,590	−5,643,694	+22,864	−868,619
Total, 1860–1921	.....	.....	28,255,558	7,965,045	16,756,460	40,605,876	4,069,526	40,456,293

[1] The figures used in this report were tabulated and the statistical tables compiled by B. N. Patchell, of the United States Geological Survey.

GOLD.

The mine production of gold in Washington increased about 6 per cent. More than 69 per cent of the gold was obtained from ores shipped directly to smelters, 27 per cent from ore treated in gold and silver mills, 2 per cent from placers, and 1 per cent from concentrates. Most of the gold, or 96 per cent, had its source in gold ore, largely from Ferry and Whatcom counties. The largest producers of gold in 1921 were the Boundary Red Mountain mine, in Whatcom County, and the San Poil, Knob Hill, and Surprise mines, at Republic, in Ferry County.

SILVER.

The mine production of silver in Washington decreased 29 per cent in quantity. Stevens County made the largest production, and Okanogan and Ferry counties followed. Crude ore shipped to smelters supplied 79 per cent of the silver, and concentrates nearly all the remainder. Copper ore contained 46 per cent of the silver, silver ore 28 per cent, and gold ore 20 per cent. The small remainder came from lead ore. The United Silver-Copper mine was the largest producer of silver in 1921, though the output was comparatively small. The next five silver producers were the Pyrargyrite, Surprise, San Poil, Knob Hill, and Arlington mines.

COPPER.

The mine production of copper in Washington decreased 87 per cent in quantity owing to curtailment in Stevens County and idleness in Snohomish County. Practically all the copper came from first-class ore smelted at Tacoma. The United Silver-Copper mine, northeast of Chewelah, was the only large producer of copper, but the output was only 29 per cent of that of 1920.

LEAD.

The mine production of lead in Washington decreased 97 per cent in quantity on account of the idleness of the Electric Point mine, in Stevens County. Some lead ore, however, was shipped from the Northport, Palmer Mountain, and Colville districts. The lead smelter at Northport was idle most of the year.

ZINC.

The output of recoverable zinc in Washington in 1921 was 449,360 pounds, valued at $22,468, an increase of 5 per cent in quantity from the production of 1920. Carbonate ore, part of which was milled, was mined near Northport. Both crude zinc ore and concentrate were shipped east.

Ore and metal produced in Washington in 1921.

Source of production.	Ore.		Gold.		Silver.	
	Short tons.	Per cent.	Fine ounces.	Per cent.	Fine ounces.	Per cent.
Dry gold ore	15,985	69.85	5,966.77	96.00	28,666	20.13
Dry silver ore	4,214	18.41	48.61	.78	40,325	28.31
Copper ore	1,332	5.82	24.91	.40	65,716	46.13
Lead ore	354	1.55	26.56	.43	7,695	5.40
Zinc ore	1,000	4.37				
Total deep mines	22,885	100.00	6,066.85	97.61	142,402	99.97
Total placers			148.66	2.39	48	.03
Total, deep and placers, 1921	22,885	100.00	6,215.51	100.00	142,450	100.00
Total, deep and placers, 1920	85,318		5,846.60		199,678	
Increase or decrease, 1921	−62,433		+368.91		−57,228	

Source of production.	Copper.		Lead.		Zinc.	
	Pounds.	Per cent.	Pounds.	Per cent.	Pounds.	Per cent.
Dry gold ore	1,213	0.48				
Dry silver ore	2,080	.83	3,339	2.32		
Copper ore	246,017	97.80				
Lead ore	2,234	.89	136,974	95.42		
Zinc ore			3,240	2.26	449,360	100.00
Total deep mines	251,544	100.00	143,553	100.00	449,360	100.00
Total deep mines, 1920	1,983,134		5,787,247		426,496	
Increase or decrease, 1921	−1,731,590		−5,643,694		+22,864	

MINING INDUSTRY.

Comparatively little mining was done in Washington in 1921, and the production of metals was consequently small. The low prices of copper, lead, and zinc, the expenses of mining and milling, and the poor market conditions discouraged most of the operators. Both the Republic and Chewelah districts were unusually quiet. A reduction in the freight rate in August made no apparent change in ore shipments. There was, however, some interest in the reorganization and development of old producers of gold and silver. One large producer of gold was again brought to a productive basis, and much zinc ore of good grade was opened in Stevens County.

METALLURGIC INDUSTRY.

Eight milling plants in Washington were active in 1921. Four of these were concentration-flotation plants, three used amalgamation, and one cyanidation.

Ore and concentrate from mines in Washington were smelted at Tacoma and Northport, Wash., Trail, British Columbia, and Bradley, Idaho. The lead plant at Northport was operated only three months, and the copper plant at Tacoma was only partly operated.

Thirteen per cent of the ore—2,960 tons—was treated by amalgamation or cyanidation, principally the former. The bullion contained gold valued at $35,078 and 643 ounces of silver, or an average in both metals of $12.07 a ton. These mills used 227 pounds of mercury and 100 pounds of sodium cyanide. The consumption of mercury was 0.077 pound per ton of ore treated and 0.126 pound per ounce of bullion recovered. The consumption of cyanide was 3.33 pounds per ton of ore treated and 0.185 pound per ounce of bullion recovered.

More than 21 per cent of the output of ore was concentrated and produced 551 tons of concentrates. The greater part was zinc concentrate from the Northport district, Stevens County, and siliceous and lead concentrates from the Nespelem and Palmer Mountain districts, Okanogan County.

Production of metals from Washington concentrates in 1921.

By counties.

County.	Ore to concentrating mills.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value of concentrates.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Okanogan	4,191	203	51.67	28,668	908	12,058	.....	$30,395
Stevens	700	348	.....	.....	.....	3,240	242,720	12,282
	4,891	551	51.67	28,668	908	15,298	242,720	42,677

By kinds of concentrates.

Dry or siliceous	176	46.37	27,283	.....	485	.....	$28,263
Lead	27	5.30	1,385	908	11,573	.....	2,132
Zinc	348	.....	.....	.....	3,240	242,720	12,282

Average content.

Kind of concentrates.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*	
Dry or siliceous	176	0.26	155.02	.....	0.14	.....	$160.59
Lead	27	.20	51.30	1.68	21.43	.....	78.96
Zinc	348	.....	.....	.....	.46	34.87	35.29
	551	.09	52.03	.08	1.39	22.03	77.45

Nearly 66 per cent of the ore was mined and shipped directly to smelters, and most of it came from Ferry and Stevens counties. Of the shipping ore, 88 per cent was dry or siliceous ore. All the copper ore shipped was sulphide and all the zinc ore oxidized.

Mine production of metals from Washington crude ore shipped to smelters in 1921.

By counties.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Ferry	13,055	4,270.45	28,561	1,213	.....	.....	$116,995
Okanogan	127	20.70	9,341	3,406	13,244	.....	10,805
Stevens	1,852	27.15	75,189	246,017	115,011	206,640	122,994
	15,034	4,318.30	113,091	250,636	128,255	206,640	250,794

By kinds of ore.

Dry or siliceous	13,209	4,272.15	41,065	3,293	2,854	.....	$129,932
Copper	1,332	24.90	65,716	246,017	.....	.....	97,967
Lead	193	21.25	6,310	1,326	125,401	.....	12,563
Zinc	300	.....	.....	.....	.....	206,640	10,332

Mine production of metals from Washington crude ore shipped to smelters in 1921—Con.

Kind of ore.	Ore.	Average content. Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*	
Dry or siliceous	13,209	0.32	3.11	0.01	0.01	.....	$9.84
Copper:							
Sulphide	1,332	.02	49.34	9.23	.....	.....	73.55
Lead:							
Oxidized	68	.....	1.90	.....	69.58	.....	64.51
Sulphide	125	.17	49.45	.53	12.31	.....	65.41
Zinc:							
Oxidized	300	.....	.....	.....	.....	34.44	34.44
	15,034	.29	7.52	.83	.43	.69	16.68

REVIEW BY COUNTIES.

Mine production of gold, silver, copper, lead, and zinc in Washington in 1921.

County.	Ore (short tons).	Gold. Fine ounces.	Gold. Value.	Silver. Fine ounces.	Silver. Value.
Chelan	20	10.01	$207	6	$6
Ferry	13,085	4,271.03	88,290	29,099	29,099
Kittitas	.....	137.63	2,845	46	46
Okanogan	4,353	93.02	1,923	38,017	38,017
Snohomish	.....	9.58	198	2	2
Stevens	2,552	28.06	580	75,189	75,189
Whatcom	2,875	1,666.18	34,443	91	91
	22,885	6,215.51	128,486	142,450	142,450

County.	Copper. Pounds.	Copper. Value.	Lead. Pounds.	Lead. Value.	Recoverable zinc. Pounds.	Recoverable zinc. Value.	Total value.
Chelan	.....	.....	.....	.....	.....	.....	$213
Ferry	1,213	$156	.....	.....	.....	.....	117,545
Kittitas	.....	.....	.....	.....	.....	.....	2,891
Okanogan	4,314	557	25,302	$1,139	.....	.....	41,636
Snohomish	.....	.....	.....	.....	.....	.....	200
Stevens	246,017	31,736	118,251	5,321	449,360	$22,468	135,294
Whatcom	.....	.....	.....	.....	.....	.....	34,534
	251,544	32,449	143,553	6,460	449,360	22,468	332,313

Ore sold or treated, deep mines producing, and average value of ores in Washington in 1920 and 1921, by counties.

County.	Ore sold or treated, 1921 (short tons). Total.	Increase or decrease.	Number of deep mines producing. 1920	1921	Average total value per ton.[a] 1920	1921	Average value per ton in gold and silver.[a] 1920	1921
Chelan	20	+ 16	1	1	$6.75	$10.65	$6.75	$10.65
Ferry	13,085	+ 597	8	7	11.80	8.98	11.73	8.97
King	.....	− 63	1	.....	30.05	.....	30.05	.....
Okanogan	4,353	+ 3,496	6	11	29.71	9.56	24.57	9.17
Snohomish	.....	−25,008	3	.....	9.01	.....	.76	.....
Stevens	2,552	−44,338	15	6	17.04	53.01	3.16	29.68
Whatcom	2,875	+ 2,867	1	1	52.13	12.01	52.13	12.01
	22,885	−62,433	35	26	14.06	14.38	3.95	11.70

[a] Placer product excluded.

CHELAN COUNTY.

Blewett district—A small quantity of gold ore from the La Rica mine was treated by the Amalgamated Gold Mines Co.

FERRY COUNTY.

Mine production in Ferry County, Wash., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	
1920	8	12,488	$110,278	33,274	4,113	$147,304
1921	7	13,085	88,290	29,099	1,213	117,545
Increase or decrease, 1921	−1	+597	−21,988	−4,175	−2,900	−29,759

Though the quantity of ore produced in Ferry County increased slightly, the value of the metal output was much less. With the exception of 30 tons all of the output was siliceous ore shipped directly to smelters.

Danville district.—Several cars of gold ore were shipped from the Lucile Dreyfus mine by the Chetterboy Mining Co.

Keller district.—At the Iron Creek property a trial run of ore was made in the new cyanide plant, which was completed in December.

Republic district.—Five deep mines in the Republic district produced 13,002 tons of ore, containing $87,090 in gold and 28,508 ounces of silver, valued together at $115,598, or $8.89 a ton. All the ore was a shipping product used at the smelters for its silica. No mills were operated in the district. From 1896 to the end of 1921 the district produced 562,200 tons of ore, containing $7,132,770 in gold and 2,097,952 ounces of silver, valued together at $8,427,244. The largest producers in 1921 were the San Poil, Knob Hill, Surprise, and Old Republic mines. The Last Chance mine was idle, and the active mines were operated for only a short period. The group of mines owned by the Northport Smelting & Refining Co. was not fully operated on account of the closing of the smelter at Northport in April. Lower freight rates went into effect in June but made no great change in ore shipments from the district.

KING COUNTY.

Miller River district.—No ore was shipped in 1921 from the Apex mine, formerly a producer of gold, silver, and arsenic. A large quantity of ore containing arsenopyrite and galena has been developed in the mine, but a concentration plant is needed.

KITTITAS COUNTY.

Seven small placers in the Swauk district produced gold valued at $2,845 and 46 ounces of silver. The largest production was that of the Swauk Mining & Dredging Co., which operated a small dredge part of the year. A larger dredge will probably be installed on this property, as the present plant has not proved satisfactory. The Weninger placer was operated by drift mining.

OKANOGAN COUNTY.

Eleven deep mines and one placer in Okanogan County produced 4,353 tons of ore, $1,923 in gold, 38,017 ounces of silver, 4,314 pounds

of copper, and 25,302 pounds of lead, valued in all at $41,636. There was a fair increase in the production of silver.

Conconully district.—Four deep mines in the Conconully district produced 103 tons of ore, containing $35 in gold, 8,869 ounces of silver, 3,406 pounds of copper, and 9,527 pounds of lead, valued in all at $9,773, or $94.88 a ton. Shipments of silver ore were made from the Arlington and First Thought mines, and sulphide lead ore from the Last Chance property. Galena, sphalerite, chalcopyrite, and tetrahedrite are the most prominent minerals.

Meyers Creek district.—The Eagle mine produced some ore which was treated by amalgamation.

Nespelem (Moses) district.—Three deep mines in the Nespelem district produced 747 tons of ore, containing $507 in gold, 5,923 ounces of silver, and 1,049 pounds of lead, valued in all at $6,477, or $8.67 a ton. Most of the ore came from the Apache and Panama mines and was treated by concentration at the Great Metals custom mill. At the Castle Creek property a small quantity of silver-lead ore was milled by the Tweedmont Mining & Milling Co.

Palmer Mountain district.—Three deep mines in the Palmer Mountain district produced 3,468 tons of ore, containing $954 in gold, 23,217 ounces of silver, 908 pounds of copper, and 14,726 pounds of lead, valued in all at $24,951, or $7.19 a ton. Most of the ore, or 3,444 tons, was reduced to 176 tons of concentrates. Lead ore was milled by the Four Metals Mining Co., and silver ore by the Pyrargyrite Co. The latter mine is developed by three tunnels to a depth of 750 feet and by a 200-foot winze from the lowest level. The ore contains argentite, proustite, pyrargyrite, galena, and pyrite.

PEND OREILLE COUNTY.

Newport district.—No ore was shipped from the Bead Lake property in 1921, but a mill was in course of construction.

PIERCE COUNTY.

The copper smelter and refinery at Tacoma was run at half capacity in 1921. Three blast furnaces were said to be idle, but the reverberatories were operated.

SNOHOMISH COUNTY.

Index district.—The mine and mill of the Sunset Copper Co., a large producer in 1919 and 1920, were idle throughout 1921.

Sultan district.—Two placer mines in the Sultan district produced gold and silver valued at $200.

STEVENS COUNTY.

Mine production in Stevens County, Wash., in 1920 and 1921.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	15	46,890	$2,004	134,037	847,858	5,753,709	426,496	$798,929
1921	7	2,552	580	75,189	246,017	118,251	449,360	135,294
Increase or decrease, 1921	−8	−44,338	−1,424	−58,848	−601,841	−5,635,158	+22,864	−663,635

The decrease in value of the metal output of Stevens County was mostly in lead. The average value per ton increased to $53.01, as most of the output was first-class shipping ore.

Chewelah district.—From 1901 to the end of 1921 the Chewelah district has produced 356,711 tons of ore, yielding $72,618 in gold, 1,431,108 ounces of silver, 8,826,051 pounds of copper, and 265,139 pounds of lead, having a total value of $2,956,143. The United Silver-Copper Mining Co., formerly the largest producer of copper in Washington, was active during 1921 and shipped crude ore to Tacoma, Wash., at the rate of about 100 tons a month. The milling plant was idle. The mine is opened by 7,000 feet of tunnels and drifts, and the ore is remarkable on account of the quantity of tetrahedrite.

Colville district.—Several lots of lead ore containing considerable silver were shipped from the Old Dominion mine, an old producer, 7 miles from Colville. Development work was continued, and several cars of ore mined in 1921 did not reach the smelter until the following year. Rich ore containing galena, stephanite, tetrahedrite, and sphalerite was struck on the lowest level, 600 feet below the surface. An article [2] on the history and development of the mine appeared in the Northwest Mining Truth.

Northport district.—Three deep mines in the Northport district produced 1,075 tons of ore, containing 405 ounces of silver, 99,048 pounds of lead, and 449,360 pounds of recoverable zinc, valued in all at $27,330, or $25.42 a ton. The Electric Point mine, the chief producer of the district, was idle throughout 1921, as the price of lead was low and the ore contains no silver. The mine was described in a recent publication.[3] Zinc ore and concentrates from the Maki mine, operated by T. S. Harris, were shipped to a zinc oxide plant in the East.

Orient district.—The First Thought mine, a large producer of gold from 1904 to 1910, was reorganized in December and a cyanide mill was planned. The property is said to have much ore ready for milling.

Springdale district.—The Silver Queen mine, operated by the Silver Basin Mining Co., produced several shipments of rich silver ore. Operations were resumed at the Cleveland and Aichan Bee properties.

WHATCOM COUNTY.

Mount Baker district.—The Boundary Red Mountain Co., south of Sardis, British Columbia, operated its property from July 1 to the end of the year and produced considerable gold by amalgamation. The mine is opened to the 500-foot level by 3,790 feet of drifts and adits. The ore body is a fissure vein containing chalcopyrite, pyrite, hematite, and bismuth telluride in a quartz gangue. The company was a large producer in 1916 and 1917, and the fact that it has been able to resume operations is one of the encouraging features of the mining industry in Washington.

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[2] Norman, Sidney, Old Dominion "comes back": Northwest Min. Truth, Oct. 3, 1921.
[3] Patty, E. N., Electric Point ore bodies: Northwest Min. Truth, Dec. 3, 1921, p. 11.

GOLD AND SILVER.

(GENERAL REPORT.)

By J. P. Dunlop.

PRODUCTION.

DOMESTIC PRODUCTION.

Approximate distribution, by producing States and Territories, of the production of gold and silver in the United States for 1921.

[Figures supplied by the U. S. Bureau of the Mint.]

State or Territory.	Gold.		Silver (fine ounces and value).[b]	State or Territory.	Gold.		Silver (fine ounces and value).[b]
	Fine ounces.	Value.[a]			Fine ounces.	Value.[a]	
Alabama	4	$100	4	North Carolina	82	$1,700	13
Alaska	386,927	7,998,500	753,999	Oregon	39,454	815,600	53,118
Arizona	160,498	3,317,800	2,519,200	Pennsylvania	24	500	1,707
California	728,590	15,061,300	3,606,708	Philippine Islands	60,705	1,254,900	26,392
Colorado	355,459	7,347,800	6,310,694	South Dakota	315,550	6,523,000	111,670
Georgia	53	1,100	3	Tennessee	241	5,000	106,664
Idaho	26,229	542,200	7,200,319	Texas	116	2,400	548,827
Illinois	.....	.....	1,616	Utah	91,636	1,894,300	14,028,661
Maine	9	200	.....	Virginia	29	600	8
Michigan	.....	.....	316,551	Washington	7,309	151,100	147,584
Missouri	.....	.....	63,470	Wyoming	.....	.....	65
Montana	83,476	1,725,600	9,677,020		2,422,006	50,067,300	53,052,441
Nevada	155,791	3,220,500	6,998,774				
New Mexico	9,824	203,100	579,374				

[a] Gold value $20.67 per fine ounce.
[b] Valued at $1 per ounce, as provided by the Pittman Act of Apr. 23, 1918, for silver from domestic mines.

The figures in this table were obtained through cooperation between the United States Bureau of the Mint and the United States Geological Survey and were agreed upon after conference and adjustment between the two bureaus. They are therefore final for both.

The totals are based on bullion deposits in the United States mints and assay offices and on returns to the Bureau of the Mint from the smelting and refining companies. The distribution is adjusted by means of information collected by the United States Geological Survey directly from the producing mines and tabulated for the mines reports later discussed. The data for the total production and in part for the distribution are obtained from records of (1) the unrefined domestic gold and silver deposited in United States mints and assay offices, (2) the domestic gold and silver in fine bars reported by private refineries, and (3) the unrefined domestic gold and silver contained in ores and matte exported for reduction. The last item is small.

Increase or decrease in production of gold and silver in the United States for 1921.

State or Territory.	Gold.		Silver.	
	Fine ounces.	Value.	Fine ounces.	Value.
Alabama	−6	−$100	−1	−$1
Alaska	−25,988	−537,200	−68,411	−149,229
Arizona	−79,534	−1,644,100	−2,912,437	−3,446,204
California	+12,113	+250,400	+1,952,055	+1,789,452
Colorado	−7,759	−160,600	+1,143,821	+636,072
Georgia	+19	+400	−1	−1
Idaho	+3,561	+73,600	−164,466	−888,204
Illinois			−7,009	−7,857
Maine	+9	+200		
Massachusetts	−10	−200	−1,160	−1,274
Michigan			−195,113	−245,394
Missouri	−14	−300	−59,624	−71,720
Montana	−8,326	−172,100	−3,586,336	−4,889,726
Nevada	−19,660	−406,400	−483,092	−1,218,335
New Mexico	−11,896	−245,900	−120,371	−189,135
North Carolina	+28	+600	+3	+2
Oregon	−10,260	−212,100	−48,540	−58,530
Pennsylvania	+24	+500	+1,617	+1,608
Philippine Islands	−1,051	−21,700	+4,274	+2,100
South Carolina	−14	−300	−1	−1
South Dakota	+105,708	+2,185,200	+24,047	+15,436
Tennessee	−44	−900	−586	−11,126
Texas	+111	+2,300	+26,009	−25,368
Utah	−11,339	−234,400	+2,273,250	+1,118,046
Virginia	+29	+600	+8	+8
Washington	+149	+3,100	−30,174	−47,642
Wyoming	−10	−200	−56,894	−62,491
	−54,160	−1,119,600	−2,309,132	−7,749,514

Domestic smelters and refiners produced 604,605 fine ounces of gold and 50,818,637 fine ounces of silver from foreign ores and bullion, a decrease of 23,821 ounces of gold and of 6,989,874 ounces of silver compared with the corresponding figures for 1920. The foreign ores came mainly from Mexico, Canada, and Peru.

The value of the new gold used in the arts and industries in the United States in 1921 was $23,050,232, compared with $54,009,609 in 1920, and the quantity of new silver used for such purposes was 28,843,628 fine ounces, compared with 19,280,129 ounces, The consumption of new silver in the arts and industries in 1921 was equal to 54 per cent of the domestic production and that of gold to 46 per cent of the domestic production. In addition to the gold and silver derived from foreign and domestic ores and bullion $27,628,938 of gold and 7,024,318 fine ounces of silver were recovered from old jewelry, dental waste, silverware, and other old material.

PRICES OF SILVER.

The average monthly prices of foreign fine bar silver in New York in 1921 were as follows:

Price of foreign silver per fine ounce in 1921, by months.

January	$0.66388	August	$0.62070
February	.59813	September	.66235
March	.56736	October	.71373
April	.59830	November	.68470
May	.60310	December	.66250
June	.59125	Average	.63117
July	.60798		

Silver to be salable to the Director of the Mint under the Pittman Act and mint regulations, must be of undoubted domestic production and reduction, and the benefit of the higher price must have been given to the owner of the producing mine.

Price of domestic silver per fine ounce, 1865–1921.[1]

1865	$1.337	1884	$1.11	1903	$0.54
1866	1.339	1885	1.07	1904	.58
1867	1.33	1886	.99	1905	.61
1868	1.326	1887	.98	1906	.68
1869	1.325	1888	.94	1907	.66
1870	1.328	1889	.94	1908	.53
1871	1.325	1890	1.05	1909	.52
1872	1.322	1891	.99	1910	.54
1873	1.297	1892	.87	1911	.53
1874	1.278	1893	.78	1912	.615
1875	1.24	1894	.63	1913	.604
1876	1.16	1895	.65	1914	.553
1877	1.20	1896	.68	1915	.507
1878	1.15	1897	.60	1916	.658
1879	1.12	1898	.59	1917	.824
1880	1.15	1899	.60	1918	.980
1881	1.13	1900	.62	1919	1.12
1882	1.14	1901	.60	1920	1.09
1883	1.11	1902	.53	1921	1.00

PRODUCTION OF GOLD AND SILVER SINCE 1792.

Gold and silver produced in the United States, 1792–1921.

[The estimate for 1792–1872 is by R. W. Raymond, commissioner, and for the period since 1872 by the Director of the Mint.]

Period.	Gold.		Silver.	
	Fine ounces.	Value.	Fine ounces.	Commercial value.
1792–1847	1,186,977	$24,537,000	309,500	$404,500
1848–1872	58,279,781	1,204,750,000	118,568,200	157,749,900
1873–1921	140,948,071	2,913,655,200	2,493,566,337	1,980,732,477
	200,414,829	4,142,942,200	2,612,444,037	2,138,886,877

Although the output of gold during the period 1792–1921 was less than one-thirteenth the output of silver in quantity, its value was nearly twice that of the silver.

The average commercial value per fine ounce of silver for the 129 years contributing to the total domestic production was nearly $0.819. Fluctuations in value of silver per fine ounce are shown in the curve in figure 10. For the years shown (1871 to 1921, inclusive), the average annual value was more than $0.80 before 1893, and it has been less than that figure every year since, until 1917, when it was $0.82; 1918, when it was $0.98; 1919, when it was $1.12; 1920, when it was $1.09; and 1921, when it was $1.00.

[1] Based on London price of bar silver 1.000 fine and taken at average price and par of exchange, 1865–1915; New York dealers' buying price for 1916–1919; average buying price of silver from domestic mines for 1920 and 1921.

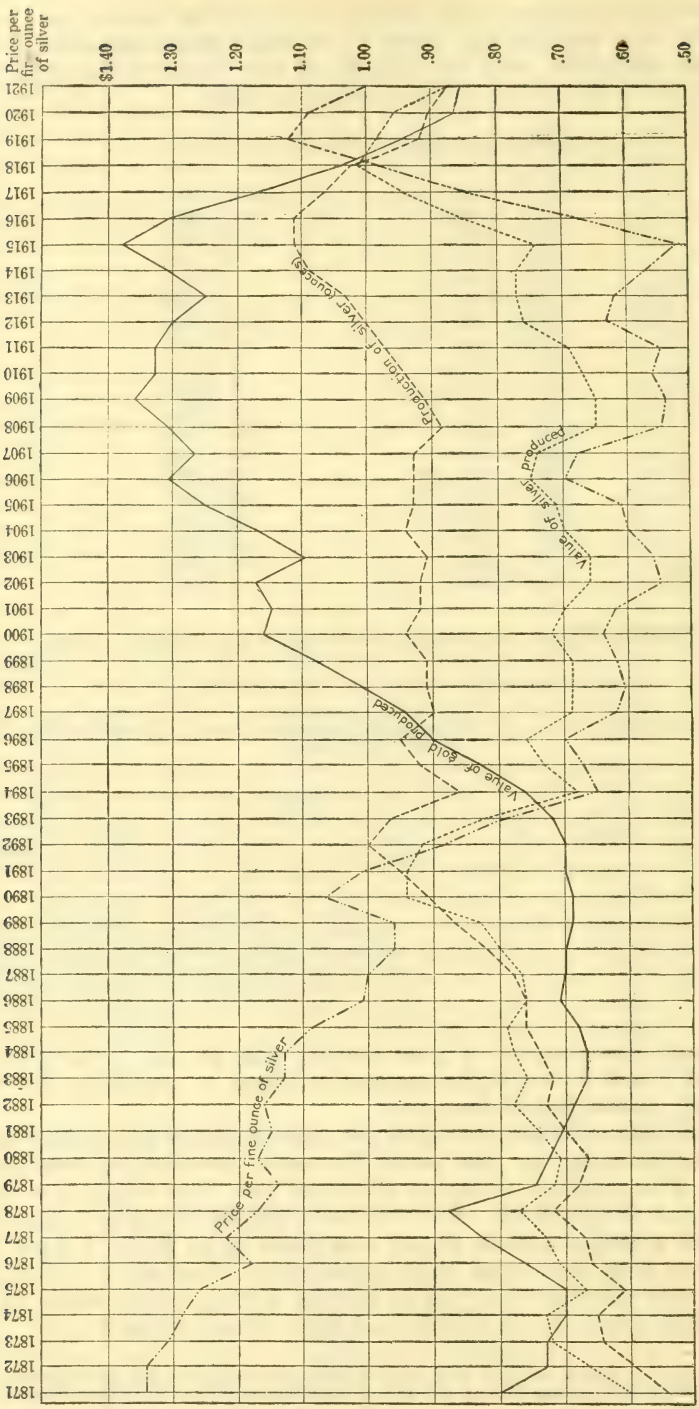


FIGURE 10.—Curves showing production and value of gold and silver and price per fine ounce of silver in the United States, 1871–1921.

IMPORTS AND EXPORTS.

Value of gold and silver imported into and exported from the United States, 1920 and 1921.[a]

	Imports.	Exports.	Excess of—	
			Imports.	Exports.
1920.				
Gold:				
Contained in domestic ore and base bullion		$11,260		$11,260
Contained in foreign ore and base bullion	$16,984,171		$16,984,171	
Domestic bullion refined	3,845,775	37,203,349		33,357,574
Foreign bullion refined	322,415,060	1,901,594	320,513,466	
United States coin	18,093,178	282,293,126		264,199,948
Foreign coin	55,730,089	681,879	55,048,210	
	417,068,273	322,091,208	392,545,847	297,568,782
Excess imports over exports			94,977,065	
Silver:				
Contained in domestic ore and base bullion		16,522		16,522
Contained in foreign ore and base bullion	69,845,999	900	69,845,099	
Domestic bullion refined	3,053	4,349,365		4,346,312
Foreign bullion refined	7,871,083	89,961,684		82,090,601
United States coin	2,093,073	14,771,492		12,678,419
Foreign coin	8,246,833	4,516,261	3,730,572	
	88,060,041	113,616,224	73,575,671	99,131,854
Excess exports over imports				25,556,183
1921.				
Gold:				
Contained in domestic ore and base bullion		77,413		77,413
Contained in foreign ore and base bullion	33,564,537	476	33,564,061	
Domestic bullion refined	459,413	1,612,349		1,152,936
Foreign bullion refined	503,136,371	2,005,408	501,130,963	
United States coin	37,966,552	17,921,219	20,045,333	
Foreign coin	116,121,424	2,274,512	113,846,912	
	691,248,297	23,891,377	668,587,269	1,230,349
Excess imports over exports			667,356,920	
Silver:				
Contained in domestic ore and base bullion		13,851		13,851
Contained in foreign ore and base bullion	46,640,993	2,260	46,638,733	
Domestic bullion refined		23,625,091		23,625,091
Foreign bullion refined	7,575,122	21,077,634		13,502,512
United States coin	2,891,952	864,005	2,027,947	
Foreign coin	6,134,604	5,992,558	142,046	
	63,242,671	51,575,399	48,808,726	37,141,454
Excess imports over exports			11,667,272	

[a] According to Bureau of Foreign and Domestic Commerce, Department of Commerce.

DOMESTIC SUPPLY.

The remarkable gain in the domestic supply of gold indicated by the great excess of $530,200,000 in imports over exports in 1916, of $180,000,000 in 1917, and of $21,000,000 in 1918 had come to a halt in the early part of 1919 but was resumed in 1920, owing to large imports of foreign bullion and coin. In 1921 the excess of imports over exports reached the enormous sum of $667,356,920.

The value of the exports of silver in 1921 was approximately $62,000,000 less than in 1920, owing to the large decrease in the shipments of refined foreign bullion to China, Japan, and India. In 1920 the excess of exports over imports of silver was $25,556,000, whereas in 1921 the excess of imports over exports of silver was about $11,667,000.

The total number of silver dollars remelted under the Pittman Act was 270,232,722, which, if all had been of exact legal weight, would have contained 209,009,120.9 fine ounces of silver but which

actually yielded on remelting 208,622,056.8 fine ounces. The purchases of silver from domestic mines in 1920 at the price fixed under the Pittman Act amounted to 29,907,361 fine ounces. The purchases in 1921 by months were as follows, in fine ounces: January, 4,677,188; February, 4,615,842; March, 5,912,065; April, 4,334,741; May, 6,836,500; June, 4,442,000; July, 4,670,119; August, 4,913,614; September, 3,471,436; October, 5,917,997; November, 3,447,000; December, 5,424,025; total, 58,662,527. The total purchases under the Pittman Act to December 31, 1921, were 88,569,888 fine ounces. The purchases in the first nine months of 1922 were as follows, in fine ounces: January, 2,532,000; February, 3,444,740; March, 6,938,980; April, 6,549,748; May, 4,122,400; June, 5,204,750; July, 2,841,000; August, 8,325,000; September, 4,377,445. The total purchases under the Act to September 30, 1922, have been 132,905,951 fine ounces, leaving 75,716,106 ounces to be purchased.

Resumption of mining at base-metal mines will increase the quantity of domestic silver, but it is impossible at present to predict when the total purchases will reach the total quantity of silver necessary to replace the silver dollars remelted. From present indications the period required will probably be about one year from January 1, 1923.

The domestic supply of new gold comes chiefly from dry or siliceous gold ores, treated mainly in gold mills by amalgamation or cyanidation or both and partly by smelting, and from placer gravels worked largely by dredges. As shown on page 452 these ores and placer gravels supplied nearly 95 per cent of the yield of gold in 1921. Considerable gold is usually recovered also from the refining of copper bullion from copper ores, especially in the West Mountain or Bingham district, Utah, and the Summit Valley or Butte district, Mont. In 1921 the copper ores of the United States produced only 2.25 per cent of the total gold, against 7.2 per cent in 1920. The natural tendency has been for the proportionate output from gold ores to decrease with declining yield from some of the principal gold camps and for that from copper ores to increase, with a general net decline of total yield of gold owing to the preponderant output from gold and gold-silver ores. This tendency was suspended in 1921, owing to the large decrease in the output of copper.

The principal domestic supply of new silver came from dry or siliceous silver and silver-gold ores, copper ores, lead ores, and lead-zinc ores in the proportion of 51.88, 10.36, 32.30, 4.30 per cent, respectively, in 1921, against 36.22, 21.49, 30.19, 8.56 per cent, respectively, in 1920. The greater part of the dry and siliceous silver ores is milled and cyanided at or near the mines, but a small quantity of richer ore is shipped to copper and lead smelters. The silver obtained as a by-product from copper, lead, and zinc ores is derived from refining the copper and lead bullion produced in smelting those and other ores.

WORLD'S PRODUCTION OF GOLD.[1a]

The value of the gold produced in the world from 1860 to 1921, inclusive, was $14,004,835,624.

In 1921 the estimated production of gold in the world decreased $7,145,300, after a decrease of about $28,769,000 in 1920, of $15,136,000 in 1919, and of $38,500,000 in 1918. The production in the

[1a] See also pp. 513–564.

United States decreased about $1,119,600; Mexico, $1,026,200; Africa, $4,645,700; Australasia, $1,915,100; India, $600,900. There was an increase of $3,255,000 in Canada and small increases in some Central American and South American countries.

In the following table is shown the output of gold, by countries, as given by the Bureau of the Mint:

World's production of gold, 1916–1921.

Country.	1916	1917	1918	1919	1920	1921
North America:						
United States	$92,590,300	$83,750,700	$68,646,700	$60,333,400	$51,186,900	$50,067,300
Canada	19,235,000	15,273,000	14,687,900	15,850,400	15,853,500	19,108,500
Mexico	7,690,700	9,000,000	16,824,700	15,676,500	15,265,900	14,239,700
Africa	222,948,900	214,304,300	197,073,600	193,896,500	191,339,800	186,694,100
Australasia	40,475,800	34,398,100	29,268,600	26,911,500	22,651,700	20,736,600
Europe:						
Russia, Finland, and Siberia	22,500,000	18,000,000	12,000,000	11,000,000	1,182,900	930,200
Austria-Hungary	1,000,000	150,000	180,000	.....	.....	.....
Sweden	12,200	10,000	10,000	10,000	4,700	4,000
Italy	2,000	700	22,800	15,300	15,000	10,000
France	1,000,000	700,000	500,000	151,000	.....	.....
Germany	.....	.....	.....	.....	91,700	93,000
Jugoslavia	.....	.....	.....	.....	66,500	82,400
Great Britain	5,700	5,000	.....	.....	700	.....
Greece	.....	.....	.....	4,600	10,600	10,000
Czechoslovakia	.....	.....	.....	125,600	181,100	235,900
South America:						
Argentina	15,300	4,600	4,000	4,000	100,000	75,000
Bolivia and Chile	301,000	770,700	770,000	770,000	905,000	806,000
Colombia	6,173,900	5,000,000	4,866,500	6,000,000	5,800,000	6,000,000
Ecuador	560,000	887,800	800,000	800,000	750,000	738,500
Brazil	2,890,000	2,958,000	2,800,000	2,000,000	2,600,000	2,780,000
Venezuela	1,269,900	636,900	473,200	600,000	389,400	231,800
Guiana—						
British	660,700	519,000	400,000	335,200	200,000	265,200
Dutch	438,200	445,000	322,200	329,300	258,500	250,000
French	1,600,000	1,438,500	1,100,000	1,100,000	900,000	1,000,000
Peru	1,267,400	1,254,100	1,250,000	1,348,400	1,297,300	1,599,700
Uruguay	12,000	10,000	10,000	10,000	400	7,000
Central America	3,517,600	3,122,000	3,400,000	3,300,000	3,000,000	2,500,000
Asia:						
Japan	5,185,600	4,679,700	5,105,900	4,824,900	5,130,400	4,747,700
China	3,100,700	3,600,100	3,600,000	3,300,000	2,584,000	2,067,200
Indo-China	65,600	50,000	50,000	40,000	3,300	3,300
Chosen (Korea)	4,122,400	3,363,800	3,300,000	2,800,000	1,571,100	1,550,400
India, British	11,206,500	10,812,800	10,028,000	10,486,000	10,316,700	9,715,800
East Indies, British East Indies, Dutch.	3,000,000	2,853,700	2,571,400	2,564,000	2,479,500	2,446,600
Federated Malay States	327,900	342,400	345,300	339,000	265,700	276,700
Formosa	1,001,200	1,081,200	513,700	417,200	279,000	248,100
Sarawak	.....	.....	.....	446,000	338,000	353,300
	454,176,500	419,422,100	380,924,500	365,788,800	[a] 337,019,300	[b] 329,874,000

[a] Revised figures. [b] Revised figures will be given in the report for 1922.

Estimates have been made for the years from 1916 to 1921 for some foreign countries that produce comparatively small quantities of gold, because of the difficulty of obtaining accurate statistics since the beginning of the World War. For a few other countries, because of the lack of basis for estimates, the figures for preceding years have been repeated. The statistics were mainly adjusted in conference between the Mint and the Geological Survey.

The notable increase of total world's output of gold culminated in a record of $468,724,918 in 1915. Since 1915 there has been a steady yearly decrease, and the output in 1921 was $138,850,000 less than that of 1915.

The present tendency, in the absence of discovery of new gold fields and development on a large scale, is toward a declining world's output of new gold; and this tendency is accentuated by the high cost of labor and supplies, which makes the operation of many gold mines unprofitable. In 1921 increases in the production of Canada and some South American countries were more than offset by decreases in the United States, South Africa, Mexico, Australia, and India.

In 1922 there will probably be moderate increases in Canada, the United States, and a few other countries, but the world's output of gold will probably not show any radical increase.

WORLD'S PRODUCTION OF SILVER.[1a]

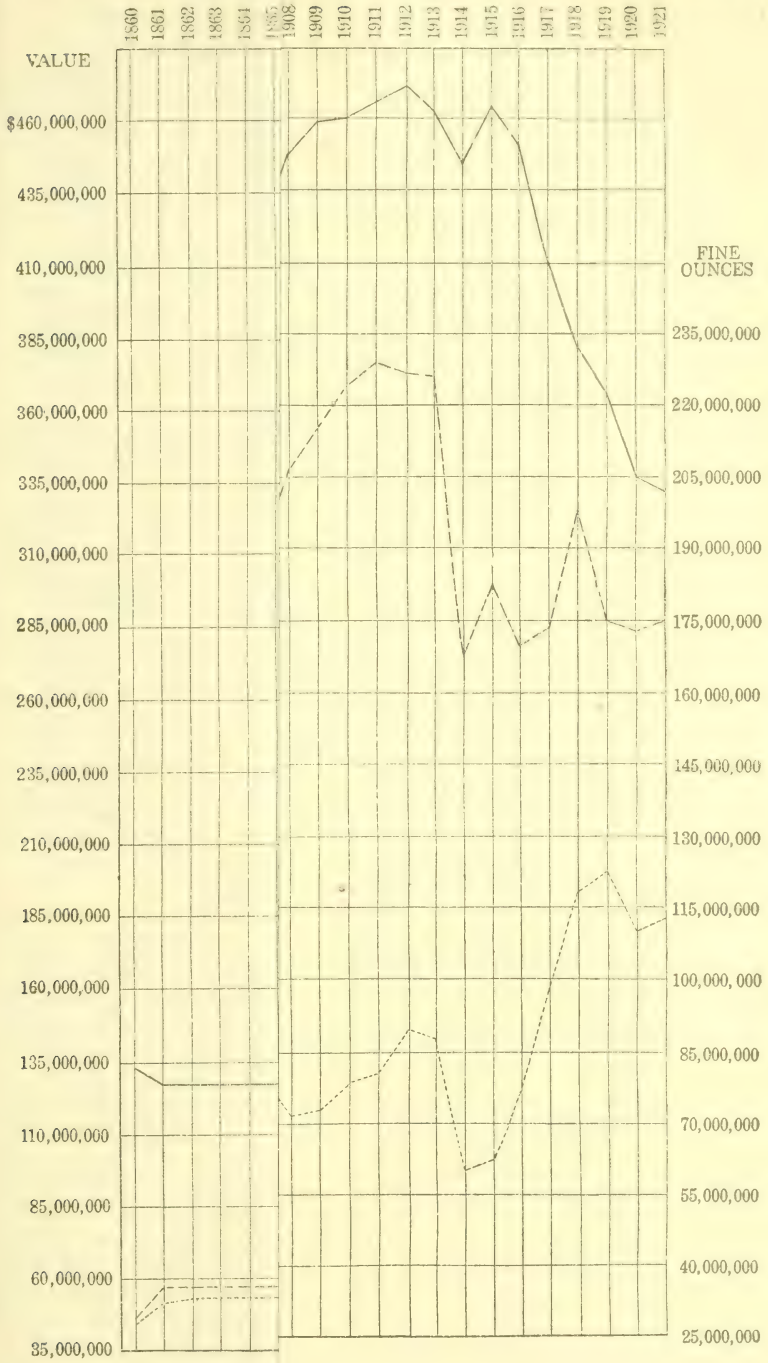
The figures for the world's production of silver in 1921 show that the United States and Canada produced 38 per cent, against 39 per cent in 1920, and that Mexico, Central America, and South America produced nearly 47 per cent, so that approximately only 27,501,800 ounces of silver came from all other countries, mainly from Australia, Japan, Burma, and Spain. There was a decrease of 2,148,700 ounces in the quantity of silver produced in Mexico in 1921, a decrease of 2,309,000 ounces in the United States, and an increase of 341,400 ounces in Canada. The total increase in the world's production of silver in 1921 was about 2,033,000 ounces.

There will probably be an increase in the world's production of silver in 1922, owing to increased activity at copper mines in the United States and Chile, and at lead and zinc mines in Burma, Mexico, Australia, and the United States. It is improbable, however, that the production will be much greater in 1922 than in 1921, for the increased activity at base-metal mines was confined mainly to the later part of 1922 and no new large silver-producing districts were developed. As the silver produced from domestic mines was purchased in 1922 by the United States Mint, all the silver consumed in the arts and industries was from foreign sources. Many European countries issued subsidiary coinage containing less silver than formerly, and large quantities of silver coins were remelted and sold. It is impossible under present trade and monetary conditions to predict the price of foreign and domestic silver when the United States Government purchases are concluded.

The value of the silver produced in the world in 1921, at $0.63117 per fine ounce, was about $110,640,500, and the total value from 1860 to 1921, inclusive, was $6,087,789,100.

Most of the world's output of silver is produced or refined in the United States, but a large part of it is consumed in Great Britain, India, and China, and the price of silver has been dominated by the London market. "Silver, its romance and history," by Benjamin White, contains information relating to the buying and selling of silver and the fixing of market quotations, which was quoted in the chapter on gold and silver in Mineral Resources for 1918.

[1a] See also pp. 513–564.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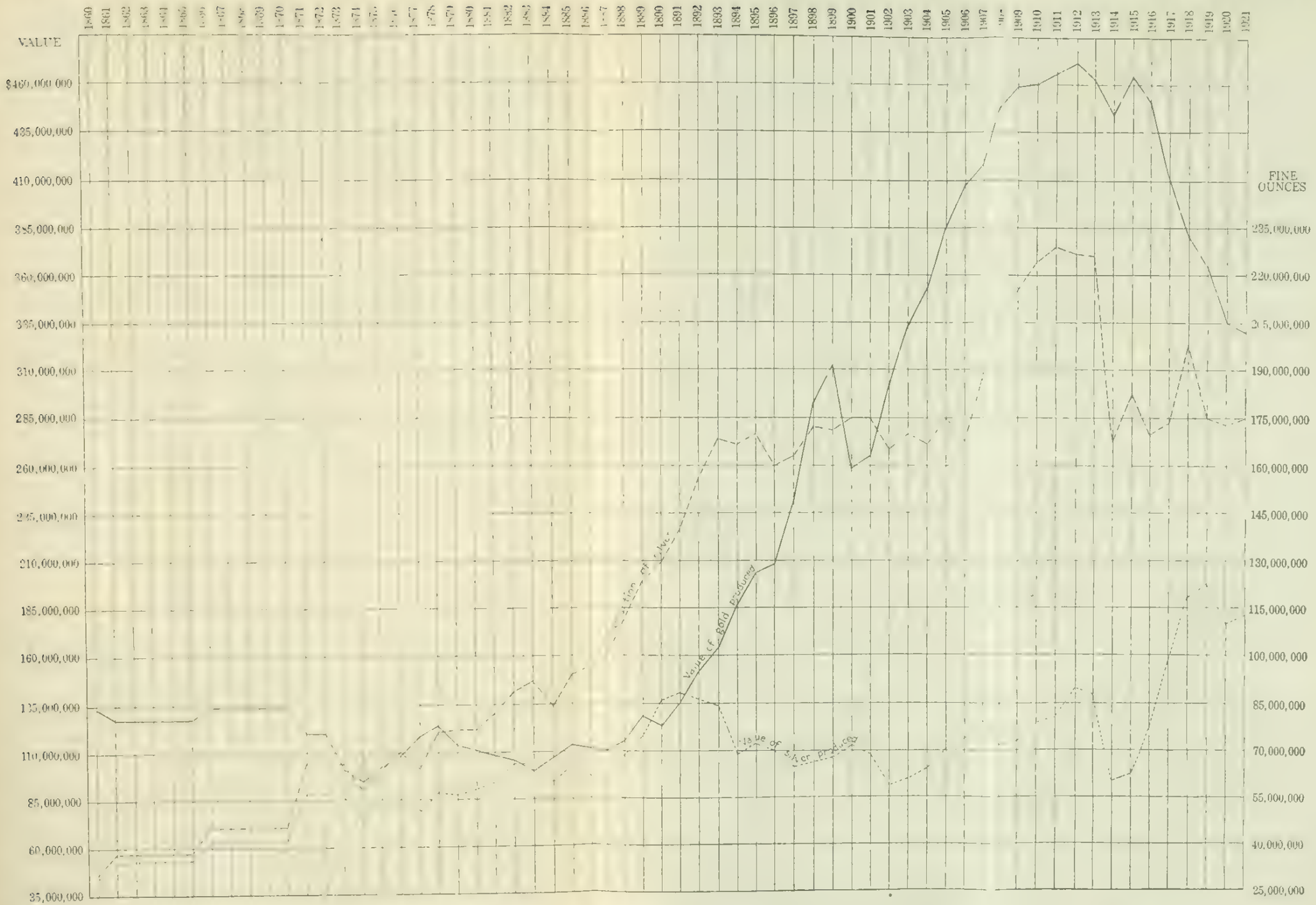

CURVES SHOWING PRODUCTION AND VALUE OF GOLD AND SILVER IN THE WORLD, 1860-1921.

56020°—23. (Face p. 436.)

World's production of silver, 1916–1921, in fine ounces.

Country.	1916	1917	1918	1919	1920	1921
North America:						
United States	74,414,800	71,740,400	67,810,100	56,682,400	55,361,600	53,052,400
Canada	25,459,700	22,221,300	21,284,600	16,020,700	12,793,500	13,134,900
Mexico	22,838,400	35,000,000	62,517,000	65,904,200	66,662,200	64,513,500
Central America	2,602,500	2,369,500	2,900,000	2,800,000	2,700,000	2,000,000
South America:						
Bolivia and Chile	4,402,100	4,151,600	4,335,000	4,335,000	4,804,400	4,600,000
Argentina	21,300	29,000	25,000	25,000	30,000	25,000
Brazil	22,000	25,000	25,000	25,000	30,000	33,000
Colombia	309,400	325,000	325,000	494,300	480,000	500,000
Ecuador	30,000	45,000	40,000	40,000	35,000	66,000
Peru	10,787,000	10,864,400	10,800,000	9,821,700	9,196,300	9,853,900
Guiana and Uruguay	8,500	8,000	8,000	8,000	8,500	11,000
Venezuela		3,300	3,000	4,100	3,500	2,700
Europe:						
Czechoslovakia				596,400	694,100	718,100
Austria-Hungary	1,500,000	1,500,000	1,750,000			
France				12,000	321,500	321,500
Germany					3,305,000	3,375,800
Jugoslavia					15,000	15,900
Great Britain	86,500	75,000	50,000	68,400	76,400	11,300
Greece	350,000	350,000	350,000	160,000	220,900	192,900
Italy	486,500	486,500	500,000	350,000	297,500	199,300
Norway	439,100	294,900	270,200	312,800	323,200	323,200
Spain and Portugal	4,517,800	2,850,000	3,100,000	1,548,200	2,956,500	2,679,400
Russia	550,000	500,000	400,000	400,000	50,000	40,000
Serbia	10,000	20,000	20,000	20,000		
Sweden	37,900	35,000	31,500	31,500	11,600	13,300
Turkey	500,000	400,000	400,000	100,000	100,000	100,000
Australasia	10,700,000	10,000,000	10,000,000	7,188,000	2,684,900	9,446,400
Asia:						
British India	280,000	275,000	270,000	190,600	170,600	150,000
China	30,000	63,900	70,000	65,000	50,000	40,000
Chosen (Korea)	25,000	26,500	26,000	20,000	1,200	1,000
Dutch East Indies	400,000	400,000	400,000	1,006,800	1,027,900	1,022,000
Indo-China	1,000	1,000	1,000	1,000		
Formosa	47,700	39,600	26,900	25,000	20,000	15,000
Japan	5,805,700	7,111,700	6,600,400	4,950,500	4,892,400	3,994,000
Burma	977,100	1,793,700	1,970,500	1,975,000	2,700,000	3,677,900
Sarawak				6,300	5,200	3,400
Africa:						
Algeria				170,800	150,000	150,000
Belgian Kongo	11,000	10,300	10,500	10,000	10,700	5,800
Egypt	1,200	900	800	300	300	
French East Africa	20,000	20,000	20,000	17,700	13,800	12,900
Madagascar						
Rhodesia	200,700	212,000	175,700	180,600	164,900	161,900
Transvaal, Cape Colony, Natal	968,900	938,100	877,500	891,300	891,300	830,300
Portuguese East Africa	1,200	1,200	1,200	1,000	700	500
	168,843,000	174,187,800	197,394,900	176,459,600	[a]173,260,600	[b]175,294,200

[a] Revised figures. [b] Revised figures will be given in the report for 1922.

The domination by the London market is not viewed complacently by many producers, refiners, and sellers of silver in the United States, who control between 85 and 90 per cent of the world's production. The production of domestic mines will have to compete with foreign silver about January, 1924, and unless foreign countries resume the purchase of silver for subsidiary coinage nearly all the silver produced in this country must be absorbed by the Orient or used in the arts and industries. Open-market conditions and price fixing at London appear to forecast prices per ounce much lower than that obtained under the Pittman Act. There is said to be considerable interest in the proposed Silver Export Association to control a more orderly marketing of the silver refined in the United States when it must compete in international markets, for the decisive factor in the price of silver will be its use in coinage. A study of the effects of the World War on the movement and markets for silver is given in "Silver for 1914–1920," by André Pailhas (Paris, Librairie générale de droit et de jurisprudence, 1922).

MINES REPORT.

METHOD OF COLLECTING STATISTICS.

The first table below presents the final official figures of the production of gold and silver in the United States in 1921 as agreed upon by the Bureau of the Mint and the United States Geological Survey. With the comparatively unimportant exceptions of domestic gold and silver contained in ores and mattes exported for reduction during the year, these figures record the actual production of gold and silver bullion from domestic ores in marketable form as metals, either refined or unrefined.

Owing to the difficulty of tracing this total gold and silver produced back to its source by States, counties, and mining districts, however, the Geological Survey attacks this problem of distribution by systematic investigation of the "mine production" of ores containing gold and silver during the calendar year and of the output of the placer mines. In this way the state of the mining industry is studied in detail, and the output is classified by methods of production and by kinds of ore, as well as by mining districts. The resulting figures form the basis of the mines reports.

Of the two plans for ascertaining the gold and silver production of the United States one is a measure of the mining industry and the other a measure of the metallurgic industry; one reports the mine output and its recoverable content and the other the metal actually recovered in marketable form. The two methods will not produce exactly corresponding results, but the figures for a period of years sufficiently long to compensate for overlap or lag should agree within allowable limits of error due to the complexity of the problem involved.

Gold and silver produced in the United States, 1905–1921, according to mint and to mine returns.

Year.	Mint.		Mine.	
	Gold.	Silver.	Gold.	Silver.
		Ounces.		*Ounces.*
1905–1915	$1,038,286,100	671,818,275	$1,031,369,692	672,280,562
1916	92,590,300	74,414,802	92,822,430	78,875,176
1917	83,750,700	71,740,362	82,032,745	70,665,531
1918	68,646,700	67,810,139	67,701,936	68,063,090
1919	60,333,400	56,682,445	58,225,112	51,907,869
1920	51,186,900	55,361,573	50,537,281	56,559,022
1921	50,067,300	53,052,441	49,788,750	46,197,490
	1,444,861,400	1,050,880,037	1,432,477,946	1,044,548,740

These figures show, according to the reports of the Mint, a total excess of gold for the 17 years of $12,383,454, or a difference of less than 0.9 per cent, and a total excess of silver of 6,331,297 ounces, or a difference of about 0.6 per cent. The figures for Alaska placers are not considered to be so closely approximate as the total figures for gold, hence the differences for the United States proper are probably even lower. It is thought that those small differences are fully accounted for in the detailed discussions of the subject in previous reports of this series. For any one year an excess of mining over

smelting and refining is indicated by larger returns in the mines reports for gold or silver, or both, and an excess of smelting and refining and drawing upon stocks is indicated by larger returns in the report of the Mint.

UNITS OF MEASUREMENT.

In the measurement of ores and concentrates the short ton of 2,000 pounds is used throughout. The price of gold is fixed by law at $20.67+ per fine ounce. The annual average prices for silver from 1865 to 1921 are given on page 431.

PRODUCTION OF GOLD AND SILVER REPORTED FROM THE MINES.

The following table gives the quantity and value of the output of recoverable gold and silver ("mine production") by States reported from the producing mines in 1921 to the United States Geological Survey. The increase or decrease of production shows results by comparison with the corresponding Geological Survey mine figures for 1920.

Mine production of gold and silver in the United States in 1921.

State.	Gold.		Silver.		Increase or decrease.	
	Fine ounces.	Value.	Fine ounces.	Value.	Gold.	Silver (fine ounces).
Alabama					−$296	−9
Alaska	390,557.50	$8,073,540	761,085	$761,085	−292,020	−192,461
Arizona	141,753.41	2,930,303	2,469,394	2,469,394	−1,855,819	−2,885,909
California	759,720.76	15,704,822	3,629,223	3,629,223	+1,393,779	+1,922,896
Colorado	330,658.99	6,835,328	5,631,657	5,631,657	−740,991	+222,322
Georgia	49.44	1,022	4	4	+290	−190
Idaho	26,399.73	545,731	6,080,528	6,080,528	+60,141	−1,246,266
Illinois			1,345	1,345		−6,848
Massachusetts and Pennsylvania					−178	−1,250
Michigan			310,727	310,727		−159,462
Missouri			69,902	69,902		−41,226
Montana	71,631.91	1,480,763	6,558,713	6,558,713	−370,402	−6,020,465
Nevada	160,254.62	3,312,757	7,083,782	7,083,782	−253,971	−661,311
New Mexico	9,521.26	196,822	571,899	571,899	−283,480	−196,143
North Carolina	153.78	3,179	18	18	+2,032	+8
Oregon	42,668.39	882,034	42,120	42,120	−135,456	−40,623
Philippine Islands	63,521.04	1,313,096	26,191	26,191	+36,535	+4,073
South Carolina	2.42	50			−282	−1
South Dakota	319,524.95	6,605,167	112,464	112,464	+1,928,697	+21,669
Tennessee	238.00	4,920	98,762	98,762	−910	−11,957
Texas			355,109	355,109		−156,292
Utah	85,619.15	1,769,905	12,251,998	12,251,998	−244,651	−854,978
Virginia	36.91	763	8	8	+763	+8
Washington	6,215.51	128,486	142,450	142,450	+7,626	−57,228
Wyoming	3.00	62	111	111	+62	+111
	2,408,530.77	49,788,750	46,197,490	46,197,490	−748,531	−10,361,532

The decrease of $748,531 in the production of gold in 1921 followed a decrease of $7,687,831 in 1920, of $9,476,824 in 1919, of $14,330,809 in 1918, and of $10,789,685 in 1917. The decrease of 10,361,532 ounces in silver followed an increase of 4,651,153 ounces in 1920 and a decrease of 16,155,221 ounces in 1919.

The principal gold-producing States in 1921 were California, Alaska, Colorado, South Dakota, Nevada, and Arizona, and these six States together made 87 per cent of the total output. The only

notable increases in gold were in South Dakota, California, and Idaho. The most notable decreases in gold were in Arizona, Colorado, Montana, Alaska, New Mexico, Nevada, Utah, and Oregon.

The principal silver-producing States in 1921 were Utah, Nevada, Montana, Idaho, Colorado, and California, and these six States together produced more than 89 per cent of the total for the United States. The comparatively large decreases in 1921 were in Montana, Arizona, Idaho, Utah, Nevada, New Mexico, and Alaska. There were increases in California, Colorado, and South Dakota.

About $30,022,000 in gold, or 60 per cent of the entire output in the United States in 1921, was produced by 25 companies, none of which produced less than $300,000. The largest producer was the celebrated Homestake mine in South Dakota. Twenty-one of the larger properties produced gold from dry or siliceous ores, three produced it from gravels by dredging, and one recovered gold in the treatment of lead ores. Eight of the largest producers of gold in 1921 were in California, five in Colorado, five in Alaska, two each in Arizona and South Dakota, and one each in Nevada, Utah, and Montana.

Larger producers of gold in the United States in 1921, in order of output.

Rank.	Operator.	State.	Mining district.	Source of gold.
1	Homestake Mining Co.	South Dakota.	Whitewood	Dry and siliceous ores.
2	Yuba Consolidated Goldfields.	California	Marysville	Dredging gravels.
3	Natomas Co. of California	do	Oroville and Folsom	Do.
4	United Eastern Mining Co.	Arizona	Oatman	Dry and siliceous ores.
5	Cresson Consolidated Mining Co.	Colorado	Cripple Creek	Do.
6	Chichagoff Mining Co.	Alaska	Sitka	Do.
7	Empire Mines	California	Grass Valley	Do.
8	Portland Gold Mining Co.	Colorado	Cripple Creek	Do.
9	Carson Hill Gold Mines	California	Mother Lode	Do.
10	Alaska Juneau Mining Co.	Alaska	Juneau	Do.
11	North Star Mines	California	Grass Valley	Do.
12	Alaska Gastineau Mining Co.	Alaska	Juneau	Do.
13	Tomboy Gold Mines Co.	Colorado	Upper San Miguel	Do.
14	United States Smelting, Refining & Mining Co.	Utah	West Mountain	Lead and lead-zinc ores.
15	Argonaut Gold Mining Co.	California	Mother Lode	Dry and siliceous ores.
16	Vindicator Consolidated Gold Mining Co.	Colorado	Cripple Creek	Do.
17	Plymouth Consolidated Mining Co.	California	Mother Lode	Do.
18	Elkoro Mines Co.	Nevada	Jarbidge	Do.
19	Tom Reed Gold Mining Co.	Arizona	Oatman	Do.
20	Alaska United Mining Co.	Alaska	Juneau	Do.
21	Central Eureka Mining Co.	California	Mother Lode	Do.
22	Smuggler Union Mining Co.	Colorado	Upper San Miguel	Do.
23	Kuskokwim Dredge Co.	Alaska	McKinley	Dredging gravels.
24	Trojan Mining Co.	South Dakota.	Bald Mountain	Dry and siliceous ores.
25	Barnes King Development Co.	Montana	Ottawa	Do.

Exclusive of the output of gold by the large producing operators, $19,766,000 came from the operation of 3,200 placer and deep mines, many of which produced between $100,000 and $300,000 each. Hundreds of mines, especially placer properties in California, Oregon, Idaho, Alaska, Arizona, and the Appalachian States, produced very small quantities of gold, and the average output of the smaller mines was $6,200.

The largest output of silver was that of the mines operated or leased by the California Rand Silver (Inc.). Of the mines enumerated in the subjoined list, 3 recovered silver from copper ore, 12 from lead ore, 9

from dry and siliceous ores, and 1 from zinc-lead ore. The California Rand mine in California and the Presidio mine in Texas were the largest producers of silver from ore that contained no appreciable quantity of any other metal. The output of the 25 properties was 27,903,000 ounces, or more than 60 per cent of the total production of silver in the United States in 1921, as against 50 per cent in 1920. Nine of the largest producers were in Utah, three in Montana, four in Idaho, five in Nevada, and one each in California, Colorado, Texas, and Arizona.

Larger producers of silver in the United States in 1921, in order of output.

Rank.	Operator.	State.	Mining district.	Source of silver.
1	California Rand Silver (Inc.)	California	Randsburg	Dry and siliceous ores.
2	Chief Consolidated Mining Co.	Utah	Tintic	Lead and siliceous ores.
3	Tintic Standard Mining Co.	do	do	Do.
4	Anaconda Copper Mining Co.	Montana	Summit Valley (Butte)	Copper ores.
5	Federal Mining & Smelting Co.	Idaho	Hunter	Lead ores.
6	Tonopah-Belmont Development Co.	Nevada	Tonopah	Dry and siliceous ores.
7	Davis Daly Copper Co.	Montana	Summit Valley (Butte)	Copper ores.
8	Bunker Hill & Sullivan Mining Co.	Idaho	Yreka	Lead ores.
9	West End Consolidated Mining Co.	Nevada	Tonopah	Dry and siliceous ores.
10	Hecla Mining Co.	Idaho	Leland	Lead ores.
11	Smuggler Union Mining Co.	Colorado	Upper San Miguel	Siliceous ores.
12	Tonopah Extension Mining Co.	Nevada	Tonopah	Dry and siliceous ores.
13	Elm Orlu Mining Co.	Montana	Summit Valley (Butte)	Lead-zinc ores.
14	Vipont Silver Mining Co.	Utah	Ashbrook	Dry and siliceous ores.
15	United States Smelting, Refining & Mining Co.	do	West Mountain	Lead ores.
16	Tonopah Mining Co.	Nevada	Tonopah	Dry and siliceous ores.
17	Rochester Silver Corp.	do	Rochester	Do.
18	Eagle & Blue Bell Mining Co.	Utah	Tintic	Lead and siliceous ores.
19	Ontario Silver Mining Co.	do	Uintah	Lead ores.
20	Bingham Mines Co.	do	Tintic	Do.
21	Judge Mining & Smelting Co.	do	Snake Creek	Do.
22	Silver King Coalition Mining Co.	do	Uintah	Do.
23	Calumet & Arizona Mining Co.	Arizona	Warren	Copper ores.
24	Hercules Mining Co.	Idaho	Leland	Lead ores.
25	Presidio Mining Co.	Texas	Shafter	Siliceous (silver) ores.

MINE PRODUCTION OF GOLD AND SILVER, BY STATES.

ALASKA.

The total production of gold in Alaska from the earliest mining in 1880 to the end of 1921 is estimated at $328,104,093, and that of silver at 10,733,647 fine ounces.

Gold.—The yield from siliceous ores decreased from $4,473,687 in 1920 to $3,818,226 in 1921; that from copper ores increased from $18,873 to $27,471; the placer output increased from $3,873,000 to $4,226,000. Twenty-four dredges produced $1,582,520 of the placer gold, which was $452,588 more than the dredge output in 1920.

The 2,894,813 tons of siliceous ores treated in 1921 yielded an average of $1.35 in gold and silver a ton, and the 477,121 tons of copper ore contained $1.20 in gold and silver a ton.

About 47 per cent of the total output of gold in Alaska came from gold lode mines in 1921, against 53 per cent in 1920, 47 per cent in 1919, 37 per cent in 1918, 31 per cent in 1917, and 29 per cent in 1912. The 651 placers operated in 1921 yielded 4,812,700 cubic yards of auriferous gravel, of which the dredges handled 2,800,000 cubic yards and made an average recovery of 57 cents a cubic yard in 1921, against 69 cents in 1920, 77 cents in 1919, and 57 cents in 1918. The estimated

total recovery of gold by dredging for the period 1903-1921 is $23,107,452.

No important new placer-bearing areas were reported in 1921.

Silver.—The mine production of silver in Alaska in 1921 was 761,085 fine ounces, against 953,546 ounces in 1920. The copper mines produced 545,229 ounces, a decrease of 136,804 ounces; the siliceous ores 99,515 ounces, against 246,292 ounces in 1920; and the placers 22,565 ounces, against 25,221 ounces. Lead ores yielded 93,776 ounces in 1921.

ARIZONA.

Gold.—The mine production of gold in Arizona in 1921 was $2,930,303, or $1,855,819 less than in 1920. Placers contributed only $12,524. The deep mines produced $2,917,779, of which 83 per cent came from dry and siliceous ores mined chiefly in Mohave, Yavapai, and Cochise counties, and 15 per cent was contained in copper ores mined chiefly in Cochise and Yavapai counties. Mohave County had a gold output of $2,333,506, Cochise County of $381,841, and Yavapai County of $112,984. The gold recovered from ores treated at gold and silver mills represented about 80 per cent of the total output, against 60 per cent in 1920, and crude ores shipped to smelters contained about 16 per cent. The crude copper ores mined and smelted directly (without previous concentration) contained an average gold content of about 63 cents a ton.

Silver.—The mine production of silver in Arizona decreased from 5,355,303 fine ounces in 1920 to 2,469,394 ounces in 1921. Of this output 1,241,436 ounces came from copper ores, 580,349 ounces from dry and siliceous ores, 645,563 ounces from lead ores, and 1,956 ounces from copper-lead ores. Cochise County produced 1,467,145 ounces in 1921, of which 651,301 ounces came from copper ores and 360,918 ounces from siliceous ores; and Yavapai County produced 383,193 ounces, derived mainly from copper ores. Bullion recovered from gold and silver ores, almost all by cyanidation, contained 134,726 ounces of silver, concentrates 320,573 ounces, and crude ore shipped to smelters 1,971,116 ounces.

CALIFORNIA.

Gold.—In 1921 the deep mines produced $7,549,998 (an increase of $299,568), of which gold-quartz ores yielded 99.1 per cent. California placers in 1921 produced $8,154,824 in gold, or $1,094,211 more than in 1920. Of the placer production $7,756,787 was recovered by dredging. The total dredge production from 1896 to the end of 1921 has been $124,999,984, and the production by dredges in 1921 was equal to 49 per cent of the total gold for 1921. The Yuba County dredges, 10 in number, made the largest output, the value being $4,722,564, an increase of $1,266,112. Sacramento County, with 7 dredges working, made an output of $1,687,646, an increase of $112,902. In Butte County (including Oroville and other districts) 4 dredges produced $420,017 in gold, or $21,633 less than in 1920. Dredges were also operated in Calaveras, Amador, Stanislaus, Placer, Shasta, and Trinity counties.

Five of the 31 counties reporting mine production of gold each had a yield of more than $1,000,000 in 1921. Of these Yuba and

Sacramento obtained most of their gold by dredging; Amador and Calaveras are on the Mother Lode; and Nevada County produced mainly from siliceous ores of the Grass Valley district. The five Mother Lode counties—Amador, Calaveras, Eldorado, Mariposa, and Tuolumne—whose output is mainly gold milling ores, produced $2,820,455 in gold from mill bullion and $863,102 from concentrates in 1921, against $2,558,597 from mill bullion and $862,845 from concentrates in 1920.

Silver.—The mine production of silver in California in 1921 was 3,629,223 fine ounces—an increase of 1,922,896 ounces. Siliceous ores yielded 3,329,530 ounces, copper ores 175,870 ounces, lead ores 82,267 ounces, zinc ores 2,926 ounces, and placers the remainder. The only counties producing more than 100,000 ounces of silver in 1921 were San Bernardino and Plumas. About 91 per cent of all the silver was recovered from crude ores sent to smelters.

COLORADO.

Gold.—The total mine production of gold in Colorado in 1921 was $6,835,328, a decrease of $740,991, following decreases of $2,310,308 in 1920, $2,865,091 in 1919, $2,977,506 in 1918, and $3,424,597 in 1917. The Cripple Creek district, with a decrease of $32,115, produced $4,291,883 in gold, or 63 per cent of the State output from all sources.

The San Juan region, in Dolores, La Plata, Ouray, San Juan, and San Miguel counties, produced $1,597,358; and Lake County produced $309,144, a decrease of $459,221. Siliceous and dry ores, 96 per cent of all the ore sold or treated, yielded 93 per cent of the total output of gold; a little more than 1.5 per cent came from lead ore, 5 per cent from placers, and the remainder from other classes of ore.

The placer production in 1921 was $344,640, a decrease of $169,948. Dredges in Summit County produced more than 98 per cent of the placer gold.

Silver.—The mine production of silver in Colorado in 1921 was 5,631,657 fine ounces, an increase of 222,322 ounces. Lake County, principally Leadville, produced 1,043,497 ounces, a decrease of 56,191 ounces. San Miguel County produced 1,776,963 ounces, an increase of 712,296 ounces. Siliceous and dry ores yielded nearly 83 per cent of the silver recovered, lead ores 9.3 per cent, and copper ores 6.8 per cent. The remainder came from placers, zinc ores, and copper-lead ores.

IDAHO.

Gold.—The mine production of gold in Idaho in 1921 was $545,731, an increase of $60,141. The total production of gold from Idaho from the discovery of placer gold in 1863 to the end of 1921 is estimated by C. N. Gerry[2] at $133,358,344.

Boise County produced about 47 per cent of the total output in 1921. The lode mines produced gold valued at $364,131 and the placers at $181,600, of which $151,762 was won by dredging. The total output of gold recovered by dredges from 1897 to the end of 1921 has been $4,439,560. Of the total gold in 1921 about 33 per

[2] U. S. Geol. Survey Mineral Resources, 1921, pt. 1, p. 399.

cent came from placers, 52 per cent from siliceous ores, 5 per cent from copper ores, and the remainder from lead and copper-lead ores.

Silver.—The mine production of silver in Idaho in 1921 was 6,080,528 fine ounces, or 1,246,266 ounces less than in 1920. The total silver from Idaho for the period 1863 to 1921, inclusive, amounts to 252,864,673 fine ounces.[3]

Shoshone County produced 82 per cent of the total silver in 1921, 87 per cent in 1920, 86 per cent in 1919, 92 per cent in 1918, 93.4 per cent in 1917. Lead ores contained 94 per cent of the output of silver in 1921 and copper-lead ores 5 per cent. Crude ore shipped, which averaged 22.69 ounces of silver a ton, supplied nearly 25 per cent of the silver, and concentrates, which averaged 22.65 ounces of silver a ton, contained 75 per cent of the total silver.

MICHIGAN.

Silver.—The copper mines of Michigan produced 310,727 fine ounces of silver in 1921, against 470,189 fine ounces in 1920. The silver was derived mainly from the electrolytic treatment of 27,434,650 pounds of copper. The average recovery of silver per ton of "rock" treated was 0.27 ounce.

MISSOURI, OKLAHOMA, ILLINOIS, AND KENTUCKY.

Silver.—The lead and zinc mines of the Central States produce no gold and only a small quantity of silver. Nearly all the silver is a by-product from the refining of lead from concentrates of lead ores mined in southeastern Missouri. The total yield of silver from Missouri in 1921 was 69,902 fine ounces, which was derived from lead recovered from 44,000 tons of galena concentrates.

The lead-zinc fluorspar deposits of the Kentucky-Illinois field carry silver, and from the lead concentrates shipped from Illinois in 1921 a recovery of 1,345 ounces of silver was obtained, against 8,193 ounces in 1920. The average silver content per ton recovered from lead concentrates from Illinois in 1921 was 7.43 ounces. No silver ore was shipped from the Criswell mine, near Byars, McClain County, Okla., in 1921.

MONTANA.

Gold.—The mine production of gold in Montana decreased from $1,851,165 in 1920 to $1,480,763 in 1921. The placer output was $227,161—a decrease of $61,785. Madison County had the largest total output, $435,463. Most of the placer gold was recovered by one company, which operated a dredge in Alder Gulch, in Madison County. Lewis and Clark County produced $376,585, and Silver Bow County $283,502 chiefly from copper and silver ores. At amalgamation and cyanidation plants $582,064 in gold was recovered, an average of $7.66 per ton of ore and tailings treated. Ore treated at concentration mills yielded concentrates containing $257,606, or $1.22 a ton, and crude ore shipped to smelters contained $397,155 in gold, an average of $3.32 a ton.

[3] U. S. Geol. Survey Mineral Resources, 1921, pt. 1, p. 399.

Silver.—Montana mines produced 6,558,713 fine ounces of silver in 1921, a decrease of 6,020,465 ounces. The copper ores yielded 1,663,472 ounces (an average of 1.8 ounces per ton), of which Silver Bow County (Butte) supplied 1,660,273 ounces. The lead-zinc ores produced 1,968,371 ounces, of which Silver Bow County supplied 1,890,393 ounces. The dry and siliceous ores produced 1,546,910 ounces, of which Silver Bow County supplied 822,857 ounces from silver ores.

NEVADA.

Gold.—The mine production of gold in Nevada in 1921 was $3,312,757, against $3,566,728 in 1920. The Goldfield district produced $146,782, against $155,789 in 1920. Nye County produced $1,340,178, of which $999,094 was from Tonopah, whose decrease was $57,892.

Silver.—The mine production of silver in Nevada in 1921 was 7,083,782 fine ounces, against 7,745,093 ounces in 1920. Nye County (almost wholly from the Tonopah district) again led with 4,699,710 ounces, about 204,000 ounces less than in 1920. All but 544,268 ounces came from dry and siliceous ores, and 88 per cent of the State output was recovered by cyanidation.

NEW MEXICO.

Gold.—The mine production of gold in New Mexico in 1921 was $196,822, against $480,302 in 1920. Catron County produced $126,791; Hidalgo County, $23,628; Grant County, $17,628.

Copper ores contained only 630 ounces of gold and dry and siliceous ores, 8,390. The output from other kinds of ore was very small, and the placer output was only about 400 ounces.

Silver.—The mine production of silver in New Mexico decreased from 768,042 fine ounces in 1920 to 571,899 ounces in 1921. Catron County produced 310,774 fine ounces, chiefly from siliceous ores. Copper ores yielded only 24,489 ounces and lead and copper-lead ores only 59,946 ounces. The output of silver from Grant County increased from 81,299 ounces in 1920 to 106,272 ounces in 1921.

OREGON.

Gold.—The mine production of gold from Oregon decreased from $1,017,490 in 1920 to $882,034 in 1921. The placer mines produced $478,733, or $27,616 more in 1921 than in 1920. Nearly 98 per cent of the output from deep mines was from siliceous ores. The deep mines of the State produced $403,301, a decrease of $163,072. Three dredges in Baker County and one dredge in Grant County produced $381,960, and a few drift and hydraulic mines and surface placers in Baker, Coos, Curry, Douglas, Grant, Jackson, Josephine, Malheur, and Wheeler counties produced the remainder of the gold. Baker, Grant, and Josephine counties produced more than $100,000 each in gold.

Silver.—The mine production of silver in Oregon in 1921 was 42,120 fine ounces—a decrease of 40,623 ounces. Of the total production 36,490 ounces came from siliceous ores, 1,339 ounces from copper ores, and 4,291 ounces from placer bullion.

SOUTH DAKOTA.

The total value of the gold produced in South Dakota from 1876 to the end of 1921 is given by Charles W. Henderson,[4] of the United States Geological Survey, as $230,228,836, and the total output of silver for the same period as 6,913,457 fine ounces.

Gold.—The mine production of gold in South Dakota in 1921 was $6,605,167, against $4,676,470 in 1920. The output was almost wholly from siliceous milling ores of low grade. Nearly 67 per cent was recovered by amalgamation and the remainder by cyanidation. The Homestake mines and mills produced $6,227,194 gold in bullion from 1,620,588 tons of ore treated.

The small yield of placer gold (89 ounces) came from Pennington and Custer counties.

Silver.—The mine output of silver, derived mainly from refining the gold bullion produced, was 112,464 fine ounces, or 21,669 ounces more than in 1920.

SOUTHERN APPALACHIAN STATES.

Gold.—The total production of gold from 1799 to the end of 1921 in the southern Appalachian States, as shown from data compiled by the Bureau of the Mint and the United States Geological Survey, has been $51,045,732. The figures credit Alabama with $766,632, Georgia with $17,826,290, North Carolina with $23,632,759, Tennessee with $269,422, Virginia with $3,297,332, South Carolina with $5,181,892, and Maryland with $71,405.

The combined mine production of gold in the southern Appalachian States in 1921 was $9,934, against $8,337 in 1920. Tennessee led with $4,920; North Carolina was next with $3,179. The gold produced in Tennessee was from copper ores of the Ducktown district. The production of gold from placers amounted to 76.97 ounces. Copper ores, from Tennessee, yielded about 238 ounces of gold, and siliceous ores from North Carolina, Virginia, and Georgia yielded about 166 ounces.

Silver.—Copper ores in Tennessee yielded 98,762 ounces of silver in 1921. Siliceous ores and placer bullion yielded only 30 ounces.

TEXAS.

The total output of gold from Texas mines from 1885 to the end of 1921 is given by Charles W. Henderson as $43,607, and the output of silver for the same period was 15,648,843 ounces.

Gold.—The small annual yield of gold has been mainly a by-product, and none was reported in 1920 or 1921.

Silver.—The mine production of silver from Texas in 1921 was 355,109 fine ounces, against 511,401 ounces in 1920. The greater part of the silver continued to come from the Presidio mine.

UTAH.

Gold.—The total output of gold in Utah from 1864 to 1921, inclusive, is given by V. C. Heikes,[5] of the United States Geological Survey, as $102,012,435.

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[4] U. S. Geol. Survey Mineral Resources, 1921, pt. 1, p. 364.
[5] Idem, p. 341.

The mine production of gold decreased from $2,014,556 in 1920 to $1,769,905 in 1921. The Bingham district, Salt Lake County, produced $954,525 and the Tintic district, partly in Juab County and partly in Utah County, produced $387,774. The placer gold in 1921 amounted to $414 and the output recovered by cyanidation and amalgamation was about $140,981. About 16.8 per cent of the Utah gold was derived from copper ores mainly mined in Salt Lake and Juab counties; lead ores contained 48.6 per cent.

Silver.—The total output of silver in Utah from 1864 to 1921, inclusive, has been 416,485,059 fine ounces, according to Heikes.[6]

The mine production of silver in Utah in 1921 was 12,251,998 ounces, a decrease of 854,978 ounces. The largest production was from Juab County, credited with 5,031,030 ounces (mainly from lead ores), against 4,650,273 ounces in 1920. Utah County had the next largest output, 2,559,368 ounces (from lead and siliceous ores), against 2,282,461 ounces in 1920. Of the Salt Lake County output of 1,307,382 ounces, the Bingham district produced 973,984 ounces. The Tintic district, in Juab and Utah counties, produced 7,577,202 ounces (mainly from lead ores); and the Park City region, in Summit and Wasatch counties, produced 2,187,236 ounces, mainly from lead and siliceous ores. Altogether in 1921 the lead ores of Utah yielded 5,893,497 ounces of silver, the copper ores 229,556 ounces, the copper-lead ores 40,309 ounces, and the dry and siliceous ores 6,088,635 ounces. The crude ore smelted in 1921 contained 9,337,801 ounces and concentrates contained 1,728,116 ounces.

WASHINGTON.

The total production of gold in Washington from earliest mining to the end of 1921 is given by C. N. Gerry,[7] of the United States Geological Survey, as $28,255,558, and the total production of silver as 7,965,045 fine ounces.

Gold.—The mine production of gold in Washington in 1921 was $128,486, against $120,860 in 1920. Of this production 69 per cent was derived from ores shipped directly to smelters, and 27 per cent came from gold and silver milling plants; siliceous ores supplied 97 per cent and copper ores and lead ores together less than 1 per cent. Ferry County alone produced $88,290 in 1921, against $110,278 in 1920. Nearly all the yield from Ferry County was, as usual, from the Republic district.

Silver.—The mine production of silver in Washington decreased from 199,678 ounces in 1920 to 142,450 ounces in 1921, of which Ferry County produced 29,099 ounces, mainly from siliceous ores, Stevens County 75,189 ounces, mainly from copper ores, and Okanogan County 38,017 ounces, from siliceous ores and copper ores.

WYOMING.

The total production of gold in Wyoming from 1867 to the end of 1921 is given by Charles W. Henderson[8] as $1,236,121, and the output of silver for the same period as 69,802 ounces.

Two small shipments of copper ore were made from Wyoming in 1921. The ore contained $3.46 in gold and silver per ton.

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[6] U. S. Geol. Survey Mineral Resources, 1921, pt. 1, p. 341.
[7] Idem, p. 421.
[8] Idem, p. 367.

PHILIPPINE ISLANDS.

The output of gold in the Philippine Islands from 1907 to 1921, inclusive, has been $12,948,901.

Gold.—The mine production of gold for 1921 was $1,313,096, against $1,276,561 in 1920, $1,309,722 in 1919, $1,290,000 in 1918, $1,408,161 in 1917, $1,514,200 in 1916, $1,320,900 in 1915, $1,371,514 in 1914, $868,362 in 1913, and $570,212 in 1912. Siliceous ores produced $1,235,577 and placers $77,519 in 1921.

The milling plant of the Benguet Consolidated Mining Co., in the Province of Luzon, the largest producer of gold in the Philippine Islands, is described in the Mining and Scientific Press of December 4 and 11, 1920. The ore is cyanided and yields about $15 a ton in gold and silver. The cost of mining and milling the ore is about $8 a ton. Another large producer was the Colorado mine, at Aroroy.

Silver.—The mine production of silver in the Philippine Islands in 1921 was 26,191 ounces and was recovered entirely from gold bullion refined, as no attempt was made to develop the known deposits of silver ore.

NUMBER OF PRODUCING MINES.

The following table indicates the number of mines producing gold and silver in 1921. The placers are those in which the gold and the silver in natural alloy with the gold and, in a few placers, with platinum also, are recovered from gravels and sands, whether by hand washing, sluicing, hydraulicking, drifting (in frozen ground or ancient buried river channels), or by dredging. The deep mines are those producing gold and silver (from ores as distinguished from gravels) mainly from underground workings, including those whose ores are valuable chiefly for copper, lead, or zinc, but which contribute precious metals as by-products. In addition to producing mines here enumerated, many properties were being prospected and developed (though prospecting and development were less active than usual) without making any output in 1921, and many other mining claims were being held by assessment work only.

The enumeration of placer mines is less satisfactory than that of deep mines, because some of the operations are only temporary and individually small and because much of the production is made by transitory miners not regularly working placer ground. The unit so far as possible is, however, as for deep mines, not the operator, but the mining claim or group of claims.

Number of mines producing gold and silver in 1921.[a]

State.	Placer.	Deep.	Total.	State.	Placer.	Deep.	Total.
Alaska	651	32	683	North Carolina	4	3	7
Arizona	37	178	215	Oregon	84	23	107
California	279	294	573	South Carolina	1	.....	1
Colorado	15	367	382	South Dakota	6	3	9
Georgia	6	1	7	Tennessee[b]	.....	2	2
Idaho	92	133	225	Texas	.....	1	1
Illinois[b]	.....	2	2	Utah	4	134	138
Michigan[b]	.....	4	4	Virginia	.....	2	2
Missouri	.....	2	2	Washington	11	26	37
Montana	97	348	445	Wyoming	.....	2	2
Nevada	61	370	431				
New Mexico	9	40	49		1,357	1,967	3,324

[a] Philippine Islands not included.
[b] Number of mines contributing to the production of gold or silver.

Number of mines producing gold and silver, 1906–1921.

Year.	Placer.	Deep.	Total.	Year.	Placer.	Deep.	Total.
1906	2,316	2,114	4,430	1915	1,720	3,597	5,317
1907	2,586	2,604	5,190	1916	1,530	3,765	5,295
1908	2,599	2,864	5,463	1917	1,552	3,811	5,363
1909	2,187	3,183	5,370	1918	1,414	3,287	4,701
1910	2,026	3,299	5,325	1919	1,105	2,460	3,565
1911	2,146	3,553	5,699	1920	1,012	2,331	3,343
1912	2,044	3,567	5,611	1921	1,357	1,967	3,324
1913	1,774	3,502	5,276				
1914	1,815	3,158	4,973	Average	1,824	3,066	4,890

The total number of properties operated in 1921 was 1,566 less than the average for the last 16 years. The number of placer properties worked in 1921 showed an increase of 345, and the total was 959 less than the number operated in 1906. This is a natural result of the exhaustion of the rich gravels and of the acquisition of large areas of placer ground by dredge mining companies. The number of deep mines operated was 364 less than in 1920 and 1,099 less than the average for 16 years, and fewer deep mines were operated than in any other year since 1906, inclusive.

ORE PRODUCTION, CLASSIFICATION, AND AVERAGE VALUE.

The best index of deep mining is, of course, found in the quantity, metallic content, and value of ore mined, rather than in the number of mines or of operators. In the next following table are given the production of ore from mines producing gold and silver and the average extraction value of precious metals per ton.

The classification adopted is necessarily arbitrary in part. The complex nature of western ores, especially, and the gradations from one well-recognized class to another render essential a fixed terminology. The dry or siliceous ores comprise gold and silver ores proper, as well as fluxing ores carrying considerable quantities of iron and manganese oxides and very small quantities of gold and silver, and precious metal bearing ores carrying copper, lead, or zinc in quantities too low to classify them as copper, lead, zinc, or mixed ores. The distinction between gold and silver ores is not here made. The total number of silver mines and the total production of true silver ores are both very small. The copper ores include those containing 2.5 per cent or more of copper, or less than this percentage in the great disseminated copper deposits of the West and in the Lake Superior ores; in general, the lead ores are those containing 4.5 per cent or more of lead and the zinc ores are those containing 25 per cent or more of zinc, both irrespective of their precious-metal content; but ores of lower grades in lead and especially in zinc are treated profitably in many districts, and of course they are then classified as lead or zinc ores, as the case may be. The mixed ores are combinations of those enumerated.

The lead, zinc, and lead-zinc ores in many districts in the Eastern and Central States carry no appreciable quantity of gold or silver, and such ores are excluded from this report.

The total quantity of ore sold or treated from which gold or silver was produced had increased more than 20,350,000 tons in the four years prior to 1920 but decreased 23,810,300 tons in 1921. In 1921

copper ores sold or treated decreased 21,516,500 tons, zinc ores 472,100 tons, lead-zinc ores 1,321,600 tons, lead ores 315,000 tons, and copper-lead ores 12,640 tons. The quantity of dry and siliceous ores decreased only 172,400 tons.

Arizona led in quantity of ore, as its output is mainly copper ore. Alaska was second, owing to its low-grade siliceous ores. Utah was third with an output of more than 2,137,000 tons of ore, of which about two-thirds was copper ore. South Dakota, Idaho, Montana, Colorado, California, Michigan, Nevada, and New Mexico followed in order of output of ore. The bulk of the ore from South Dakota, Colorado, and California was low-grade siliceous ore, and that from Idaho was mainly lead ore. As many copper mines in Montana were inactive, a much larger proportion than usual of the ore treated consisted of siliceous ore, lead ore, and lead-zinc ore. For the first time in several years the larger part of the output of ore from Nevada was dry and siliceous ore. All the ore from Michigan was low-grade copper ore, and about 87 per cent of the ore treated from New Mexico was copper ore.

Ore produced in the United States and average extraction value of gold and silver per ton in 1921.[a]

State.	Dry and siliceous ores.		Copper ores.		Lead ores.	
	Short tons.	Average value.	Short tons.	Average value.	Short tons.	Average value.
Alaska	2,894,813	$1.35	477,121	$1.20	727	$131.53
Arizona	233,201	12.81	5,181,177	.32	40,511	17.44
California	902,566	12.00	306,134	.67	3,947	25.07
Colorado	1,230,172	8.95	22,195	18.92	18,289	34.41
Georgia	50	6.22				
Idaho	48,221	6.93	10,322	4.84	1,446,710	3.97
Michigan[b]			1,145,000	.27		
Montana	164,906	15.32	928,461	1.90	113,481	12.67
Nevada	667,560	13.92	401,153	.28	25,597	23.14
New Mexico	74,738	8.84	533,231	.07	2,514	23.66
North Carolina	1,130	2.09				
Oregon	37,935	11.36	2,398	4.30		
South Dakota	1,725,669	3.89			16	52.31
Tennessee[c]			564,457	.18		
Texas	40,056	8.87				
Utah	376,472	17.80	1,357,857	.40	401,429	16.81
Virginia	55	14.02				
Washington	20,199	9.62	1,332	49.71	354	23.29
Wyoming			50	3.46		
Total, 1921	8,417,743	6.65	10,930,888	.54	2,053,575	7.89
Percentage of quantity	39.06		50.72		9.53	
Total, 1920	8,590,139	6.26	32,447,410	.52	2,368,619	8.26
Percentage of quantity	18.94		71.54		5.22	

[a] Philippine Islands, Illinois, and Missouri not included; quantity of crude ore containing gold and silver not known.

[b] Includes only copper ore yielding gold and silver

[c] Lead ore and zinc ore yielded no gold or silver.

Ore produced in the United States and average extraction value of gold and silver per ton in 1921—Continued.

State.	Zinc ores.		Copper-lead and copper-lead-zinc ores.		Lead-zinc ores.		Total (short tons).
	Short tons.	Average value.	Short tons.	Average value.	Short tons.	Average value.	
Alaska							3,372,661
Arizona			141	$15.34			5,455,030
California	2,953	$1.35					1,215,600
Colorado	5,727	.62	820	50.56	4,178	$3.71	1,281,381
Georgia							50
Idaho	72		9,122	34.91			1,514,447
Michigan [b]							1,145,000
Montana			334	79.23	117,619	17.50	1,324,801
Nevada			1,689	12.31	139		1,096,138
New Mexico	364		378	6.75	351		611,576
North Carolina							1,130
Oregon							40,333
South Dakota							1,725,685
Tennessee [c]							564,457
Texas							40,056
Utah			1,764	23.22			2,137,522
Virginia							55
Washington	1,000						22,885
Wyoming							50
Total, 1921	10,116	.76	14,248	31.76	122,287	16.96	21,548,857
Percentage of quantity	0.05		0.07		0.57		100.00
Total, 1920	482,229	3.00	26,890	30.01	1,443,904	4.10	45,359,191
Percentage of quantity	1.06		0.06		3.18		100.00

[b] Includes only copper ore yielding gold and silver.
[c] Lead ore and zinc ore yielded no gold or silver.

Some of the States produced comparatively small quantities of copper ore containing considerable gold and silver, but the copper ores of the important copper-producing States contained very little gold and silver. The lead ores of Utah showed an average recovery in gold and silver of $16.81 a ton, and the lead ores of Idaho, the leading State, only $3.97 a ton. Of the output of ore considered as producing gold and silver, the proportion of dry and siliceous ore increased greatly, being more than 39 per cent compared with about 19 per cent in 1920, and lead ores increased more than 4 per cent, whereas copper ores decreased nearly 21 per cent. The other classes of ore, except copper-lead ore, also decreased. The average value per ton in gold and silver of siliceous ores, copper ores, copper-lead ores, and especially lead-zinc ores, of the United States increased, whereas that of lead ores and zinc ores decreased.

DISTRIBUTION OF MINE PRODUCTION OF GOLD IN 1921, BY SOURCES.

As shown in the following table, nearly 95 per cent of the domestic output of gold is obtained from dry and siliceous ore—normally gold quartz and gold-silver quartzose ores—and from placers. The total contribution of gold derived from the great copper, lead, and zinc mines of the country is therefore relatively small, notwithstanding their recent enormous development and production of ore, and this contribution in 1921 was less than normal, owing to the lessened quantities of base ores treated.

The contribution of gold from dry and siliceous ores, which had gradually declined from 69 per cent in 1910 to 66 per cent in 1914 and has fluctuated since then, was 66.02 per cent in 1921. The contribu-

tion of gold from copper ores increased from 6 per cent in 1914 to 9.6 per cent in 1918, decreased to 6.78 per cent in 1919, increased to 7.18 per cent in 1920, and decreased to 2.25 per cent in 1921.

Mine production of gold in the United States in 1921, in fine ounces.[a]

State.	Placers.	Dry and siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alaska	204,432.75	184,706.68	1,328.91	89.16	.....	.....	.....	390,557.50
Arizona	605.85	116,457.77	21,732.17	2,947.62	.....	10.00	.....	141,753.41
California	394,489.61	362,934.22	1,439.01	806.93	50.99	.....	.....	759,720.76
Colorado	16,671.95	307,016.96	1,811.24	5,089.73	13.91	24.60	30.60	330,658.99
Georgia	34.40	15.04	.....	.....	.....	.....	.....	49.44
Idaho	8,784.90	13,826.54	1,258.62	2,467.70	.....	61.97	.....	26,399.73
Montana	10,988.91	47,377.95	4,733.30	4,151.98	10.59	.....	4,369.18	71,631.91
Nevada	17,566.99	133,294.94	4,747.21	4,614.98	.....	30.50	.....	160,254.62
New Mexico	400.59	8,389.83	630.01	100.83	.....	.....	.....	9,521.26
North Carolina and South Carolina	42.57	113.63	.....	.....	.....	.....	.....	156.20
Oregon	23,158.71	19,075.66	434.02	.....	.....	.....	.....	42,668.39
South Dakota	89.44	319,435.51	.....	.....	.....	.....	.....	319,524.95
Tennessee	.....	.....	238.00	.....	.....	.....	.....	238.00
Utah	20.03	29,554.10	14,384.74	41,628.44	.....	31.84	.....	85,619.15
Virginia	.....	36.91	.....	.....	.....	.....	.....	36.91
Washington	148.66	6,015.38	24.91	26.56	.....	.....	.....	6,215.51
Wyoming	.....	.....	3.00	.....	.....	.....	.....	3.00
Total, 1921	677,435.36	1,548,251.12	52,765.14	61,923.93	75.49	158.91	4,399.78	2,345,009.73
Value	$14,003,832	$32,005,191	$1,090,753	$1,280,081	$1,560	$3,285	$90,952	$48,475,654
Percentage of total	28.89	66.02	2.25	2.64	0.003	0.007	0.19	100.00
Total, 1920	603,001.92	1,523,331.42	171,055.42	46,775.96	3,656.91	3,730.82	31,434.87	2,382,987.32
Value	$12,465,156	$31,490,055	$3,536,030	$966,945	$75,595	$77,123	$649,816	$49,260,720
Percentage of total	25.30	63.93	7.18	1.96	0.15	0.16	1.32	100.00

[a] Philippine Islands not included.

PLACERS.

GENERAL FEATURES.

The production of gold from placer mining in 1921 was $1,538,676 more than in 1920. The States showing a considerable increase in placer gold were Alaska (17,076 ounces), California (52,932 ounces), Idaho (3,279 ounces), Nevada (10,183 ounces), and Oregon (1,336 ounces). The only prominent decreases were in Colorado (8,221 ounces) and Montana (2,989 ounces).

The placer gold is derived chiefly from dredging (which yielded 75 per cent of the total in 1921), from drift mining (which is of decreasing importance in Alaska in frozen ground at no great depth, but of continued importance in California in ancient buried river channels, in places at considerable depth), and from hydraulic and sluicing placers. In California, especially, hydraulic mining was of much importance in the past and had become a special branch of the industry in itself but has in recent years been greatly reduced by restrictive laws relative to the débris and to disturbance of navigable streams. Finally, there is a small annual output of gold from dry placers in the Southwest and also of gold and platinum from ocean-beach mining in California and Oregon.

Some interesting notes on beach mining in California and Oregon and on dry placers in California, by Charles G. Yale, and on dry placers in Arizona, Nevada, and New Mexico, by V. C. Heikes, were published in the Survey report on gold and silver for 1912, copies of which may still be had on application to the Director, United States Geological Survey, Washington, D. C.

DREDGING.

The value of gold produced by dredging in the United States from the commercial beginning of the industry in 1896 to the end of 1921 has amounted, according to best available data, to $173,164,178, of which $124,999,984 came from California, $23,107,452 from Alaska, $9,555,494 from Montana, $6,666,769 from Colorado, $4,439,560 from Idaho, and $3,936,860 from Oregon. The production of gold from dredges in 1921 was the largest output since 1917, though the number of dredges operated in 1921 was 21 less than in 1918.

Brief details of dredging operations have been given in Mineral Resources in the mines report on gold, silver, copper, lead, and zinc in the Western States and also in earlier reports of the Director of the Mint. A brief history of gold dredging in the United States was given in the general report on gold and silver for the year 1914, and the production of gold obtained by dredging in the United States and the number of dredges operated were given by States for each year from 1896 to the end of 1914. Further information is to be found in reports of geological surveys or mining officials of different States. A comprehensive and very useful report is contained in Bulletin 57 of the California State Mining Bureau. Other valuable treatises are "Dredging for gold in California," by D'Arcy Weatherbe, published by the Mining and Scientific Press, and Bulletins 121 and 127 of the Bureau of Mines.

Gold produced in the United States by dredges, 1896–1921.

Year.	Dredges.	California.	Alaska.	All other States.[a]	Total.
1896	2	$2,000	.....	$42,000	$44,000
1897	6	5,000	.....	113,556	118,556
1898	8	18,887	.....	168,813	187,700
1899	18	206,302	.....	227,876	434,178
1900	27	200,929	.....	319,108	520,037
1901	34	471,762	.....	268,251	740,013
1902	48	867,665	.....	501,857	1,369,522
1903	45	1,475,749	$20,000	420,315	1,916,064
1904	61	2,187,038	25,000	511,679	2,723,717
1905	68	3,276,141	40,000	371,235	3,687,376
1906	76	5,098,359	120,000	503,035	5,721,394
1907	79	5,065,437	250,000	340,265	5,655,702
1908	88	6,536,189	171,000	646,481	7,353,670
1909	96	7,382,950	425,000	975,656	8,783,606
1910	115	7,550,254	800,000	942,786	9,293,040
1911	119	7,666,461	1,500,000	1,159,908	10,326,369
1912	124	7,429,955	2,200,000	1,588,956	11,218,911
1913	116	8,090,294	2,200,000	1,936,642	12,226,936
1914	120	7,783,394	2,350,000	2,379,389	12,512,783
1915	114	7,796,465	2,330,000	2,356,660	12,483,125
1916	113	7,769,227	2,679,000	2,338,487	12,786,714
1917	109	8,313,527	2,500,000	1,736,898	12,550,425
1918	93	7,431,927	1,425,000	1,485,173	10,342,100
1919	91	7,716,919	1,360,000	1,269,297	10,346,216
1920	78	6,900,366	1,129,932	1,256,158	9,286,456
1921	72	7,756,787	1,582,520	1,196,261	10,535,568
		124,999,984	23,107,452	25,056,742	173,164,178

[a] Other States that have produced gold by dredges are Colorado, which yielded in 1901–1921 $6,666,769; Idaho, 1897–1921, $4,439,560; Montana, 1896–1921, $9,555,494; Oregon, 1902–1921, $3,936,860; and New Mexico, Nevada, South Dakota, Wyoming, Washington, Alabama, Georgia, and North Carolina, combined, 1902–1921, $458,059.

Of the output in 1921 California produced $7,756,787 from 35 dredges, Alaska $1,582,520 from 24 dredges, Montana $190,416 from 1 dredge, Colorado $337,950 from 3 dredges, Idaho $151,762 from 3 dredges, and Oregon $381,960 from 4 dredges. One dredge was operated below Silver City, in Lyon County, Nev., by the Gold Canyon

Dredging Co during the latter part of 1920 and in 1921, but no dredges were working in Wyoming, South Dakota, or the Appalachian States.

DRY AND SILICEOUS ORES.

The siliceous ores are in part free-milling (amalgamating), as in Alaska, California, Arizona, and Oregon; both amalgamating and concentrating, as in many States; simply concentrating ores, as in parts of Colorado and Arizona; all-sliming and cyaniding ores; and finally smelting ores. Tailings both from old dumps and from present millings are largely reworked by concentration and subsequent cyanidation. Owing to the increase in the cost of labor and supplies in the last five or six years, much of the old tailings could not be reworked at a profit.

The material smelted consists mainly of concentrates and of siliceous and pyritic ores, which are also valuable as fluxes. Exact figures of relative output by methods and by States are given in another table.

As most of the gold produced in the United States is derived from placer gravels and dry or siliceous ores, including true gold, gold-silver, and silver ores, the following table for certain States, prepared by V. C. Heikes, is of special interest.

Gold produced in six Western States in 1916–1921.

Year.	Number of producers.	Ore mined (short tons).	Total gold (fine ounces).[a]	Gold ore.			
				Number of producers.	Short tons.	Gold content (fine ounces).	
						Total.	Average.
Arizona:							
1916	527	17,033,810	192,801.41	105	164,918	63,562.20	0.385
1917	484	15,770,193	245,173.83	86	236,585	128,801.16	.544
1918	469	19,038,486	262,919.43	63	201,411	141,126.20	.700
1919	339	13,727,403	217,997.72	34	190,069	125,188.13	.659
1920	318	14,920,478	231,528.65	41	201,334	139,857.94	.694
1921	215	5,455,030	141,753.41	26	182,194	114,044.05	.63
Idaho:							
1916	418	2,718,045	53,977.30	75	69,443	25,068.38	.361
1917	359	2,758,507	38,932.64	70	67,784	24,721.63	.365
1918	301	2,091,619	33,998.72	53	41,481	13,774.92	.332
1919	210	1,457,395	34,502.89	31	44,537	21,989.06	.493
1920	163	1,958,401	23,490.42	17	38,534	13,708.33	.355
1921	225	1,514,447	26,399.73	29	47,174	13,710.44	.29
Montana:							
1916	513	7,860,425	220,130.15	150	498,082	131,175.61	.263
1917	617	6,307,164	170,147.11	137	411,118	103,835.48	.252
1918	493	7,823,967	150,192.96	90	234,663	74,996.31	.320
1919	457	4,183,594	107,856.32	87	130,922	56,301.56	.430
1920	457	5,241,615	89,550.11	60	98,307	38,284.51	.389
1921	445	1,324,801	71,631.91	104	96,504	41,684.11	.43
Nevada:							
1916	779	5,941,165	428,904.21	308	817,100	232,699.56	.285
1917	943	6,473,519	336,664.26	287	589,228	171,815.15	.292
1918	714	6,472,579	320,239.45	195	540,320	167,878.58	.311
1919	421	3,187,831	219,695.16	94	163,279	111,170.33	.681
1920	473	3,480,620	172,540.46	106	102,772	48,873.75	.476
1921	431	1,096,138	160,254.62	122	63,850	50,699.95	.79
Utah:							
1916	318	13,920,643	172,938.06	10	1,308	663.82	.508
1917	334	15,358,481	162,305.67	6	14,728	4,678.60	.318
1918	250	14,705,718	142,666.10	10	222	359.70	1.620
1919	179	6,745,423	104,464.41	6	553	1,528.81	2.764
1920	164	6,800,180	97,454.15	3	19	85.00	4.473
1921	138	2,137,522	85,619.15	2	69	266.69	3.86
Washington:							
1916	113	164,998	27,944.06	38	70,048	26,932.84	.384
1917	136	172,119	23,816.17	23	65,058	23,166.31	.356
1918	84	138,911	14,737.83	23	45,434	14,070.56	.309
1919	49	100,879	12,232.20	11	25,648	11,951.91	.465
1920	44	85,318	5,846.60	10	12,513	5,510.88	.440
1921	37	22,885	6,215.51	9	15,985	5,966.77	.37

[a] Includes placer production, given in last column on p. 455.

Gold produced in six Western States in 1916–1921—Continued.

Year.	Gold-silver ore.		Silver ore.		Placers.	
	Short tons.	Gold (fine ounces).	Short tons.	Gold (fine ounces).	Number of producers.	Gold (fine ounces).
Arizona:						
1916	1,470	994.00	169,916	8,858.47	23	690.84
1917	1	3.62	80,817	3,192.79	32	832.73
1918	2,415	452.21	91,722	8,421.19	13	204.82
1919	19,536	6,474.19	85,070	4,279.51	15	227.07
1920	1,177	236.75	78,190	9,423.34	8	220.93
1921	75	23.67	50,932	2,390.05	37	605.85
Idaho:						
1916	447	227.19	1,793	201.15	162	21,724.87
1917	.....	.....	1,866	207.64	112	6,541.80
1918	.....	.....	4,834	478.53	85	13,371.33
1919	21	15.94	3,693	257.08	72	9,227.63
1920	5	9.55	1,272	88.49	49	5,505.76
1921	54	39.14	993	76.96	92	8,784.90
Montana:						
1916	999	176.45	24,761	4,075.20	120	34,982.82
1917	7	2.20	33,097	3,335.15	99	22,594.17
1918	233	121.33	51,626	5,495.86	86	19,167.72
1919	118	61.58	90,646	7,926.41	62	14,097.92
1920	847	423.20	79,198	6,585.71	65	13,977.76
1921	1,401	715.66	67,001	4,978.18	97	10,988.91
Nevada:						
1916	13,330	2,681.38	721,211	116,039.39	65	17,139.89
1917	17,614	3,099.45	807,087	93,757.16	91	14,153.75
1918	14,384	3,157.77	839,879	82,026.71	54	10,564.13
1919	68,874	28,478.76	551,414	54,358.94	37	6,399.43
1920	76,863	24,216.14	619,572	62,968.62	39	7,383.91
1921	60,365	18,969.68	543,345	63,625.31	61	17,566.99
Utah:						
1916	4,337	1,130.41	83,718	7,328.18	8	60.47
1917	25,318	4,864.68	124,011	10,851.33	3	5.42
1918	5	101.75	227,129	22,353.99	3	66.18
1919	14,618	3,489.71	224,517	20,198.11	.....	.....
1920	24,837	10,209.30	266,164	23,053.69	3	21.91
1921	33,616	11,769.97	342,787	17,517.44	4	20.03
Washington:						
1916	.....	.....	428	46.19	23	400.40
1917	48	30.89	533	43.41	17	283.86
1918	.....	.....	1,717	36.80	10	165.93
1919	.....	.....	3,438	65.02	7	60.32
1920	.....	.....	583	38.94	9	71.20
1921	.....	.....	4,214	48.61	11	148.66

Nearly all the siliceous ore in three of the largest gold-producing States—Alaska, California, and South Dakota—yields only small value in silver and is classed as gold ore. The siliceous ores from Colorado include some silver and gold-silver ores, but the great bulk of the siliceous ore is purely gold ore.

Siliceous ore treated and gold recovered per ton of ore treated in 1913–1921.

Year.	Alaska.		California.		South Dakota.		Colorado.	
	Ore treated.	Recovery per ton.	Ore treated.	Recovery per ton.	Ore treated.	Recovery per ton.	Ore treated.	Recovery per ton.
	Short tons.	*Ounce.*	*Short tons.*	*Ounce.*	*Short tons.*	*Ounce.*	*Short tons.*	*Ounce.*
1913	1,614,506	0.144	2,031,429	0.267	1,899,139	0.187	2,161,458	0.378
1914	1,738,127	.135	2,050,797	.264	2,019,255	.175	2,157,762	.414
1915	3,020,607	.097	2,368,352	.272	1,889,970	.189	2,183,431	.464
1916	3,548,798	.081	2,192,078	.262	1,870,721	.193	2,057,452	.412
1917	3,414,664	.065	2,018,003	.246	1,867,859	.191	1,996,590	.347
1918	2,095,577	.080	1,538,960	.261	1,781,569	.178	1,760,222	.322
1919	3,262,573	.068	1,212,142	.339	1,330,349	.177	1,667,076	.258
1920	3,413,736	.063	788,136	.439	1,356,098	.167	1,224,081	.257
1921	2,894,813	.064	902,566	.402	1,725,669	.185	1,230,172	.250

The quantity of siliceous ores treated in South Dakota in 1921 increased, and the recovery of gold per ton was slightly larger; the siliceous ore in California increased about 114,430 tons, and the gold recovery per ton was the second largest recorded for eight years.

COPPER ORES.

The gold obtained as a by-product in the smelting of copper ores sold or treated in 1921 showed a decrease in quantity and a very large decrease in percentage of the total gold yield. The largest producer was Arizona, followed by Utah, Nevada, Montana, and Colorado.

LEAD ORES.

The gold in lead ores sold or treated in 1921 came chiefly from Utah, Colorado, Nevada, and Montana, and showed an increase over the output in 1920.

LEAD-ZINC, ZINC, AND MIXED ORES.

The production of gold from zinc, lead-zinc, copper-lead, and copper-lead-zinc ores in 1921 was less than one-eighth of the production in 1920. Montana produced nearly all the gold from lead-zinc ores and California nearly all the gold from zinc ores. Idaho, Nevada, and Utah contributed nearly all the gold from copper-lead ore.

DISTRIBUTION OF MINE PRODUCTION OF SILVER IN 1921, BY SOURCES.

Mine production of silver in the United States in 1921, in fine ounces.[a]

State.	Placers.	Dry and siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alaska	22,565	99,515	545,229	93,776	.....	.....	.....	761,085
Arizona	90	580,349	1,241,436	645,563	.....	1,956	.....	2,469,394
California	38,630	3,329,530	175,870	82,267	2,926	.....	.....	3,629,223
Colorado	4,442	4,661,634	382,521	524,023	3,237	40,949	14,851	5,631,657
Georgia	3	1	.....	.....	.....	.....	.....	4
Idaho	1,686	49,034	23,987	5,688,577	.....	317,244	.....	6,080,528
Illinois[b]	.....	.....	.....	1,345	.....	.....	.....	1,345
Michigan	.....	.....	310,727	.....	.....	.....	.....	310,727
Missouri	.....	.....	.....	69,902	.....	.....	.....	69,902
Montana	1,591	1,546,910	1,663,472	1,352,125	.....	26,244	1,968,371	6,558,713
Nevada	7,956	6,539,514	19,323	496,826	.....	20,163	.....	7,083,782
New Mexico	61	487,403	24,489	57,394	.....	2,552	.....	571,899
North Carolina	4	14	.....	.....	.....	.....	.....	18
Oregon	4,291	36,490	1,339	.....	.....	.....	.....	42,120
South Dakota	7	112,457	.....	.....	.....	.....	.....	112,464
Tennessee	.....	.....	98,762	.....	.....	.....	.....	98,762
Texas	.....	355,109	.....	.....	.....	.....	.....	355,109
Utah	1	6,088,635	229,556	5,893,497	.....	40,309	.....	12,251,998
Virginia	.....	8	.....	.....	.....	.....	.....	8
Washington	48	68,991	65,716	7,695	.....	.....	.....	142,450
Wyoming	.....	.....	111	.....	.....	.....	.....	111
Total, 1921	81,375	23,955,594	4,782,538	14,912,990	6,163	449,417	1,983,222	46,171,299
Value	$81,375	$23,955,594	$4,782,538	$14,912,990	$6,163	$449,417	$1,983,222	$46,171,299
Percentage of total	0.18	51.88	10.36	32.30	0.01	0.97	4.30	100.00
Total, 1920	73,383	20,477,612	12,151,424	17,069,506	1,258,341	669,503	4,837,135	56,536,904
Value	$79,987	$22,320,597	$13,245,052	$18,605,761	$1,371,591	$729,758	$5,272,477	$61,625,223
Percentage of total	0.13	36.22	21.49	30.19	2.23	1.18	8.56	100.00

[a] Philippine Islands not included. [b] Fluorspar-lead ores.

The mine production of silver from the three most important sources of silver—dry and siliceous ores, copper ores, and lead ores—was 94.54 per cent of the total output in 1921, against 87.90 per cent in 1920. The percentage of the total output from dry and siliceous ores increased 15.66 per cent in 1921, and that from lead ores 2.11 per cent; that from lead-zinc ores decreased 4.26 per cent, and that from copper ores 11.13 per cent. The combined yield of silver from placer bullion, zinc ores, and copper-lead was only 1.16 per cent of the total.

PLACERS.

The output of silver from the refining of placer gold was 8,000 ounces more than in 1920. Of the total production 75 per cent came from Alaska and California.

DRY AND SILICEOUS ORES.

About 27 per cent of the mine production of silver from dry and and siliceous ores was from Nevada (chiefly from the Tonopah district), more than 25 per cent from Utah (mainly from the Tintic district), and nearly 20 per cent from Colorado. There were increases in the quantity of silver from siliceous ores in a few of the States especially in California, Colorado, and Utah.

A large part of the silver from gold-silver siliceous ores is obtained with the gold by amalgamation and cyanidation in the mills, and the silver is then recovered by refining the mill bullion. The remainder is produced by smelting the richer ores and refining the copper or lead bullion produced. A small quantity of silver was also recovered from the leaching of copper ores.

COPPER ORES.

The silver produced from copper ores is obtained in the electrolytic refining of Lake and blister copper produced by smelting. The copper ores are mainly sulphides (except the Lake ores of Michigan, which are native metal in amygdaloid and conglomerate matrix), and a greater quantity contains chalcocite than chalcopyrite or cupriferous pyrite. The silver tenor of the extensive disseminated deposits of the Santa Rita district, N. Mex., and of Ely, Nev., is notably low, but similar deposits elsewhere add considerable quantities of silver.

In output of silver from copper ores Montana continued to lead, though the output was only 1,663,472 ounces in 1921, against 6,030,507 ounces in 1920. Arizona was next, with 1,241,436 ounces in 1921, against 3,716,246 ounces in 1920; Alaska ranked third, with 545,229 ounces in 1921, against 682,033 ounces in 1920; and Utah produced 229,556 ounces in 1921, against 452,915 ounces in 1920. The production of Montana comes mainly from Butte, that of Arizona chiefly from Bisbee and Jerome, that of Utah from Tintic and Bingham, and that of California from Plumas County. Of these districts Bisbee well represents the disseminated type; Bingham produces from both lode and disseminated deposits; and the remainder produce silver chiefly from copper ore mined from deep lodes.

LEAD ORES.

The mine production of silver from argentiferous lead ores decreased considerably in 1921 and was the second smallest yield from this source in 13 years. The output from Idaho decreased 402,831 ounces, that of Utah decreased 2,001,510 ounces, that of Colorado decreased 317,760 ounces, and that of Montana increased 551,269 ounces. The yield of Idaho is derived mainly from the silver-lead ores of the Coeur d'Alene district, that in Utah chiefly from the Park City and Tintic districts, and that in Colorado from Aspen and Leadville. The production of silver from lead ores decreased also in Nevada, California, and Missouri. Most of the output is obtained from the desilverization of lead bullion from smelting of western ores and concentrates.

ZINC, LEAD-ZINC, AND MIXED ORES.

Silver from argentiferous zinc ores decreased greatly in 1921, because it was not profitable to ship the low-grade argentiferous zinc ores from western mines. The output was mainly a refinery by-product from the smelting of zinc concentrates from California. Silver from lead-zinc ores decreased; it came chiefly from Colorado and Montana. The output of silver from copper-lead and copper-lead-zinc ores came mainly from Idaho, Colorado, Utah, Montana, and Nevada.

PRODUCTION OF SILVER, BY SOURCES, 1905–1921.

Silver produced in the United States, by sources, as reported by mines, 1905–1921, in fine ounces.[a]

Year.	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
1905.....	112,826	17,187,889	15,762,947	16,070,203	939,252	5,416,723	782,656	56,272,496
1906.....	171,058	16,792,799	15,880,870	15,328,653	98,423	6,815,678	2,274,972	57,362,453
1907.....	126,808	19,038,042	13,955,436	17,318,811	93,419	489,825	1,474,725	52,497,066
1908.....	159,285	19,862,038	14,945,189	14,049,481	37,605	1,099,283	722,906	50,875,787
1909.....	152,040	19,826,890	18,300,705	17,027,737	313,948	549,923	1,141,434	57,312,677
1910.....	159,381	23,125,042	16,024,543	15,028,076	755,369	535,987	1,968,311	57,596,709
1911.....	170,084	25,205,749	16,759,638	15,596,638	630,573	285,006	2,460,152	61,107,840
1912.....	163,955	26,363,436	18,744,661	16,632,377	664,421	654,596	2,810,939	66,034,385
1913.....	123,739	28,010,875	18,250,253	18,629,246	86,432	752,563	5,334,120	71,187,228
1914.....	152,128	27,812,335	14,829,828	19,302,081	145,264	248,866	7,132,747	69,623,249
1915.....	154,968	25,709,505	18,781,365	19,828,533	1,136,220	234,047	6,509,092	72,353,730
1916.....	126,351	24,593,656	24,541,234	19,216,586	1,274,292	533,273	8,572,141	78,857,533
1917.....	118,604	21,489,465	20,314,233	19,096,474	549,656	448,042	8,645,038	70,661,512
1918.....	89,494	21,564,982	20,462,597	18,291,243	135,676	224,580	7,290,380	68,058,952
1919.....	78,401	19,043,515	12,880,624	14,351,293	39,480	232,157	5,273,990	51,899,460
1920.....	73,383	20,477,612	12,151,424	17,069,506	1,258,341	669,503	4,837,135	56,536,904
1921.....	81,375	23,955,594	4,782,538	14,912,990	6,163	449,417	1,983,222	46,171,299
	2,213,880	380,059,424	277,368,085	287,749,928	8,164,534	19,639,469	69,213,960	1,044,409,280

[a] Philippine Islands excluded.

The production of silver as reported by the mines had increased from 50,875,787 fine ounces in 1908 to 78,857,533 ounces in 1916. A decline during the next three years was followed by partial recovery in 1920 and a further decline in 1921, when the output was 32,686,000 ounces less than it was in 1916. The recovery from dry and siliceous ores was greatest in 1913, when the yield from the Tonopah mines was at its zenith and the production was 4,055,300 ounces more than it was in 1921. The yield of silver from copper ores in 1921 was less

than one-fifth the yield in 1916, when it reached the maximum. The combined production of silver from lead and lead-zinc ores decreased from 21,906,641 ounces in 1920 to 16,896,212 ounces in 1921.

DISTRIBUTION OF PRODUCTION OF GOLD AND SILVER, BY METHODS OF TREATMENT.

SUMMARY OF DISTRIBUTION.

In the following table is given the recoverable gold and silver content of the ore, tailings, and slag treated.

Distribution of gold and silver produced in the United States in 1921, by States.[a]

State.	Total quantity of crude ore, tailings, and slag treated or sold in 1921 (short tons).	Ore to gold and silver mills.			Crude ore.			
		Short tons.	Gold in bullion (fine ounces).	Silver in bullion (fine ounces).	To concentrating mills (short tons).	Concentrates produced from all sources.		
						Short tons.	Gold (fine ounces).	Silver (fine ounces).
Alaska	3,372,661	2,627,731	134,171	46,300	715,274	50,170	50,346	399,487
Arizona	5,455,030	184,369	[b] 113,219	[b] 134,726	3,645,245	200,957	4,653	320,573
California	1,215,600	816,159	302,732	73,763	317,493	33,062	46,620	194,854
Colorado	1,281,381	884,763	218,733	52,571	206,270	49,140	67,432	2,568,500
Idaho	1,514,447	47,203	13,685	6,019	1,182,211	201,652	2,054	4,568,360
Montana	1,324,801	65,378	[c] 28,157	[c] 34,062	724,933	210,450	12,462	4,113,520
Nevada	1,096,138	587,229	[d] 127,033	[d] 6,269,223	403,395	42,761	4,486	208,363
New Mexico	611,576	52,220	6,095	253,719	534,665	40,549	1,686	93,432
Oregon	40,333	3,200	5,068	1,840	36,298	2,555	13,716	33,238
South Dakota	1,725,685	1,725,528	319,364	111,415	.....	.....	.....	.....
Texas	40,056	40,056	.....	355,109	.....	.....	.....	.....
Utah	2,137,522	33,616	6,820	119,130	1,477,479	133,807	41,632	1,728,116
Washington	22,885	2,960	1,697	643	4,891	551	52	28,668
Wyoming	50	.....	.....	.....	.....	.....	.....	.....
Eastern or Appalachian States	565,692	1,235	166	23	102,517	8,897	13	21,865
	20,403,857	7,071,647	1,276,940	7,458,543	9,350,671	974,551	245,152	14,278,976
Total, 1920	43,738,191	6,951,460	1,214,711	7,733,818	28,046,224	3,182,704	324,958	21,516,930

State.	Crude ore to smelters.			Ore leached and old slag and tailings treated.		
	Short tons.	Gold (fine ounces).	Silver (fine ounces).	Short tons.	Gold (fine ounces).	Silver (fine ounces).
Alaska	29,656	1,608	292,733	.....	.....	.....
Arizona	665,648	23,099	1,971,116	959,768	177	42,889
California	43,649	10,610	3,300,415	38,299	5,269	21,561
Colorado	190,348	27,822	3,006,144	.....	.....	.....
Idaho	66,098	1,876	1,499,916	218,935	.....	4,547
Montana	119,785	19,212	2,240,436	414,705	812	169,104
Nevada	52,121	9,607	568,993	53,393	1,562	29,247
New Mexico	24,691	1,339	224,687	.....	.....	.....
Oregon	835	725	2,751	.....	.....	.....
South Dakota	157	72	1,042	.....	.....	.....
Utah	403,528	35,825	9,337,801	222,899	1,322	1,066,950
Washington	15,034	4,318	113,091	.....	.....	.....
Wyoming	50	3	111	.....	.....	.....
Eastern or Appalachian States	461,940	225	76,897	.....	.....	.....
	2,073,540	136,341	22,636,133	1,907,999	9,142	1,334,298
Total, 1920	4,538,682	233,530	25,338,855	4,201,825	6,786	1,284,408

[a] Exclusive of small quantity of silver from copper ores in Michigan and Missouri, from lead ores and fluorspar-lead ores in Illinois and Missouri, and siliceous ores from the Philippine Islands.
[b] Includes recoveries from 10,260 tons of old tailings.
[c] Includes recoveries from 10,621 tons of old tailings.
[d] Includes recoveries from 45,704 tons of old tailings.

The first item takes no account of placer gravel, but represents output of mines producing ore only. The greatest output was from Arizona, Utah, Montana, and Nevada, all notable for large yields of copper ores; from Idaho, a large producer of lead ores; from Alaska and California, large producers of both copper and siliceous ores; and from South Dakota and Colorado, large producers of siliceous ores.

Many gold and silver mills employ concentrating apparatus, and the concentrates they obtain are combined in the table with those from straight concentrating mills under the heading "Concentrates produced." The gold and silver included in this item are recovered mainly by amalgamation and cyanidation, as is shown in detail in the last table of this report.

The figures for the quantity of ore treated by concentration include only the large quantities of copper, lead, zinc, and mixed ores whose concentrates are smelted primarily for these metals, the gold and silver being recovered in refining the copper and lead bullion and smelting the zinc residues. Examples are the copper ores of the disseminated deposits of Bingham, Utah, and of New Mexico and Nevada; the copper ores of Butte, Mont.; and the lead and lead-zinc ores of Coeur d'Alene, Idaho, Butte, Mont., and Leadville, Colo. The quantity of concentrates produced and the recoverable gold and silver content represent not only the concentrates from these straight concentrating mills but also those from gold and silver mills, which form, however, a very small part of the total quantity of concentrates and are derived mainly from Alaska, California, and Colorado ores. These concentrates are mainly smelted but are also treated in gold and silver mills by the processes named.

The ore treated in straight concentration mills decreased materially in 1921, mainly because of the idleness or lessened activity at copper mines in Montana, Utah, Nevada, Arizona, and other States. The quantity of ore concentrated in 1921 was only one-third of that concentrated in 1920. Montana mills produced the largest quantity of concentrates, followed by those of Idaho, Arizona, and Utah. The recoverable gold content of concentrates came mainly from Colorado, Alaska, California, Utah, Oregon, Montana, Arizona, and Nevada. About 60 per cent of the recoverable silver from concentrates produced came from Idaho and Montana, and large quantities came from Colorado and Utah. The decrease was due largely to a decrease in the silver in concentrates derived from ores mined in Montana, Idaho, Arizona, and Utah.

The quantity and the recoverable precious-metal content of crude ores shipped from the mines direct to the smelters in general include the richer gold, silver, copper, lead, and mixed ores from which the gold and silver is eventually recovered by refining the copper or lead bullion that collects the precious metals in the smelting. Arizona produced about one-third of the ore directly smelted and was followed by Tennessee, Utah, Colorado, Montana, and Idaho. Utah and California produced 56 per cent of the silver recovered from crude ore smelted.

The old materials, principally tailings and slags, re-treated (with which are included ore and tailings leached) are partly smelted, often for their fluxing as well as their metal value; but considerable quantities of old tailings are now concentrated and cyanided, and the

impounding of mill tailings for future treatment as well as because of legal requirements has become a general practice. Owing to the low price of base metals there was less old slag and tailings treated in 1921 than in 1920. Most of the gold and silver derived from the old tailings is included under recoveries by amalgamation and cyanidation at gold and silver mills. The total quantity of ore leached in 1921 was 1,314,810 short tons, of which 931,049 tons was from Arizona mines, 207,187 from Utah mines, 148,900 tons from Montana mines, and 27,674 tons from Nevada mines. The ore and old tailings leached in 1920 amounted to 3,432,866 tons.

PERCENTAGE PRODUCED BY DIFFERENT PROCESSES.

Percentage of output of gold and silver produced by different processes, 1917–1921.

Process.	Gold.					Silver.				
	1917	1918	1919	1920	1921	1917	1918	1919	1920	1921
Placers	25.8	23.6	25.6	25.5	28.9	0.2	0.15	0.15	0.13	0.18
Gold and silver mills:										
By amalgamation	20.9	20.7	21.5	24.5	32.6	.4	.3	.5	.4	.45
By cyanidation	26.1	32.0	26.5	24.3	23.9	16.3	14.3	13.8	13.4	15.7
By chlorination	.2	.2								
Total milling	50.4	52.9	60.0	52.8	56.5	16.7	14.6	14.3	13.8	16.15
Smelting [a]	23.8	23.5	14.4	21.9	14.6	83.1	85.3	85.55	86.07	83.67
Total [b]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] Both crude ore and concentrates. [b] Philippine Islands and Porto Rico excluded.

The dredges produced $1,249,000 more gold in 1921 than in 1920, and the combined placer yield from hydraulic, drift, and other surface methods was $1,538,700 more than in 1920. The increase from placers was largely due to an increase of 17,076 ounces in Alaska, 10,183 ounces in Nevada, and 52,932 ounces in California. The percentage of output of silver credited to the placers is insignificant.

In the mills the proportion of gold recovered by the amalgamation process showed a gain of 4.1 per cent in 1921. The proportion of gold recovered by cyanidation showed a decrease of 0.4 per cent, following a decrease of 4.2 per cent in 1920 and of 3.5 per cent in 1919. Colorado, Nevada, Arizona, and South Dakota ores yielded the larger part of the gold recovered by cyanidation, and the decrease was due to smaller recoveries by the cyanide process in Arizona, Colorado, California, Oregon, and Alaska. The chlorination process was not used in California in 1920 or 1921.

GOLD AND SILVER PRODUCED AT MILLS, BY STATES.

A large quantity of concentrates from sulphide ores is now smelted, and the increased application of the flotation process has resulted in decreased yield of gold and silver from cyanidation, as nearly all such concentrates are shipped to smelters.

The smelters, which had for two years been producing a slightly greater proportion of gold and silver, are to be credited in 1921 with 15 per cent of the total output of gold and 84 per cent of the silver.

The bulk of the gold produced continues to come from the gold mills. As shown in the table, the proportion of gold recovered by amalgamation and cyanidation has increased from 50.1 per cent in 1916 to 56.5 per cent in 1921.

Gold and silver produced at mills in the United States in 1921, by States.[a]

State.	Ore and tailings treated (shorttons).	Bullion recovered (fine ounces).				Percentage of gold and silver from all sources in State.			
		Amalgamation.		Cyanidation.		Amalgamation.		Cyanidation.	
		Gold.	Silver.	Gold.	Silver.	Gold.	Silver.	Gold.	Silver.
Alaska	2,894,765	141,015	37,865	22,235	3,597	36.1	5.0	5.7	0.5
Arizona	194,629	862	162	112,357	134,564	.6	.....	79.3	5.4
California	823,547	283.404	67,827	38,100	12,729	37.3	1.9	5.0	.4
Colorado [b]	884,763	93,335	25,595	125,398	26,976	28.2	.5	37.9	.5
Idaho	47,203	11,098	2,957	2,587	3,062	42.0	.....	9.8	.....
Montana	75,999	1,197	883	26,960	33,179	1.7	.....	37.6	.5
Nevada	630,933	13,095	11,221	113,938	6,258,002	8.2	.16	71.1	88.3
New Mexico	52,220	912	209	5,183	253,510	9.6	.....	54.4	44.3
Oregon	3,200	4,613	426	413	1,411	10.8	1.0	1.0	3.3
South Dakota [c]	1,725,528	214,004	60,604	105,360	50,811	67.0	53.9	32.9	45.2
Texas	40,056	.....	.....	.....	355,109	.....	.....	.....	100.0
Utah	33,616	.....	.....	6,820	119,130	.....	.....	8.0	1.0
Washington	2,960	1,696	105	1	538	27.3	.1	.....	.4
Appalachian States	1,235	166	23	.....	.....	34.5	.....	.....	.....
Total, 1921	7,410,654	765,397	207,877	559,352	7,252,618	32.6	.45	23.9	15.7
Value	.....	$15,822,160	$207,877	$11,562,832	$7,252,618	.....	.....	.....	.....
Total, 1920	7,560,043	679,409	228,807	580,205	7,582,358	28.5	.4	24.3	13.4
Value	.....	$14,044,610	$249,400	$11,993,902	$8,264,770	.....	.....	.....	.....

[a] Philippine Islands excluded.
[b] Part of ore amalgamated, followed by cyanidation of slimes and sands—total ore and slimes cyanided, 484,407 tons.
[c] Also 1,564,695 tons of sands and slimes from ore amalgamated was cyanided.

Figures corresponding to those in this table have been published for the entire United States by the Geological Survey since 1911. The quantity of crude ore treated and old and new tailings re-treated in gold and silver mills reached a maximum in 1915 (11,878,287 tons). It exceeded 11,000,000 tons in 1916 and 1917, but has declined steadily since the record year, except for a small increase in 1919.

The great bulk of the ore treated was milled in Alaska, South Dakota, Colorado, California, Nevada, and Arizona, and here the famous mines and mills of the Homestake, Mother Lode, Grass Valley, Treadwell, Cripple Creek, Tonopah, Goldfield, and San Francisco (Oatman) districts are especially noteworthy. Large numbers of smaller mills, however, mark the wide distribution of gold mining in these regions and in many other scattered districts.

The total yield of gold by amalgamation in the United States in 1921 was 765,397 fine ounces, against 679,409 fine ounces in 1920, and there has been a decrease of about 199,200 ounces since 1916. Appreciable decreases were shown in Alaska, Nevada, New Mexico, and Montana, and there were increases in South Dakota, California, Colorado, Washington, Oregon, and Idaho.

The silver produced by amalgamation came mainly from California, South Dakota, Alaska, Colorado, and Nevada, and consisted chiefly of silver alloyed with gold.

The output of gold by cyanidation decreased about 21,000 ounces. It was derived mainly from Colorado, Nevada, Arizona, and South Dakota. The principal decreases were in Arizona, 25,302 ounces; Colorado, 12,589 ounces; California, 10,859 ounces; and Oregon, 10,351 ounces.

Nevada led in yield of silver by cyanidation and was followed by Texas, New Mexico, and Arizona. The most notable losses were in Colorado, 91,839 ounces, and Texas, 153,492 ounces. The only considerable gain was about 11,000 ounces in Nevada.

Of the gold-producing States whose output is derived chiefly from milling ores, Alaska, California, Idaho, and South Dakota still yield more gold by amalgamation than by cyanidation, but cyanidation produces more gold than amalgamation in Arizona, Colorado, Montana, and Nevada, and it produces much more silver in Arizona, Montana, Nevada, New Mexico, Texas, and Utah. Only in Alaska, California, and South Dakota did the recovery of silver by amalgamation exceed that by cyanidation. Altogether amalgamation produced gold and silver valued at $16,030,037 from milling ores in 1921 against $18,815,450 produced by cyanidation.

QUICKSILVER AND POTASSIUM AND SODIUM CYANIDE CONSUMED IN CERTAIN STATES.

For details of the consumption of quicksilver in the amalgamation milling process and of potassium cyanide and sodium cyanide in the cyanidation process the reader is referred to the mines reports of the several Western States. The consumption of quicksilver at mills treating ore, in dredging, and in other methods of placer mining is given in the separate chapters on quicksilver in Mineral Resources for 1917–1921.

The following tables were compiled by V. C. Heikes:

Quicksilver consumed at mills in certain Western States, 1916–1921.

State and year.	Number of mills using quicksilver.	Ore and tailings treated (short tons).	Quicksilver consumed (pounds).[a]	
			Total.	Per ounce of gold and silver bullion.
Arizona:				
1916	13	17,568	645	0.040
1917	9	21,100	205	.057
1918	7	1,389	17	.012
1919	6	2,374	33	.077
1920	4	1,688	56	.031
1921	9	1,215	68	.066
Idaho:				
1916	36	66,304	1,183	.039
1917	27	63,884	1,035	.032
1918	22	31,263	953	.057
1919	12	40,504	828	.0406
1920	9	38,556	737	.053
1921	14	44,545	355	.025
Montana:				
1916	18	18,959	206	.026
1917	13	8,925	167	.040
1918	13	6,492	99	.053
1919	17	13,142	178	.054
1920	11	27,989	250	.046
1921	13	2,562	47	.0225
Nevada:				
1916	36	131,891	2,111	.034
1917	32	67,359	839	.020
1918	34	54,048	675	.017
1919	21	60,038	1,149	.026
1920	21	41,700	631	.021
1921	23	13,143	224	.009
Utah:				
1916	4	703	15	.039
1917	2	190	5	.030
1918	2	112	2	.018
1919	.....	.....	.....	.....
1920	.....	.....	.....	.....
1921	.....	.....	.....	.....
Washington:				
1916	5	11,495	317	.027
1917	4	10,976	185	.026
1918	1	960	20	.038
1919	.....	.....	.....	.....
1920	.....	.....	.....	.....
1921	3	2,930	227	.126

State.	1916	1917	1918	1919	1920	1921
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Arizona	645	205	17	33	56	68
Idaho	1,183	1,035	953	828	737	355
Montana	206	167	99	178	250	47
Nevada	2,111	839	675	1,149	631	224
Utah	15	5	2	.....	.....	.....
Washington	317	185	20	.....	.....	227
	4,477	2,436	1,766	2,188	1,674	921

[a] Partly estimated.

Quicksilver consumed at mills in Colorado in 1921 amounted to 3,925 pounds, in New Mexico to 130 pounds, and in South Dakota to 22,500 pounds.

Potassium and sodium cyanides consumed at mills in certain Western States, 1916–1921.

State and year.	Number of mills using cyanidation process.	Ore and tailings treated (short tons).	Cyanide consumed (pounds).		
			Total.[a]	Per ton of ore and tailings.	Per ounce of gold and silver.
Arizona:					
1916	9	276,623	216,841	0.78	0.30
1917	10	227,648	157,961	.69	.43
1918	10	221,508	157,829	.71	.53
1919	8	211,199	117,489	.56	.49
1920	4	206,847	227,369	1.10	.85
1921	9	193,414	297,797	1.54	.21
Idaho:					
1916	8	3,469	4,631	1.33	.38
1917	4	3,793	4,996	1.30	.45
1918	4	9,582	15,600	1.63	4.45
1919	3	907	950	1.05	2.07
1920	1	334	1,600	4.79	2.70
1921	4	2,658	11,991	4.51	2.12
Montana:					
1916	18	381,560	203,554	.53	.69
1917	15	328,685	158,215	.48	.53
1918	14	190,119	83,542	.44	.53
1919	11	97,802	64,900	.66	.55
1920	8	60,999	105,874	1.74	1.84
1921	12	73,437	108,665	1.48	1.81
Nevada:					
1916	33	1,367,249	2,320,328	1.70	.20
1917	32	1,203,665	1,925,168	1.60	.20
1918	33	1,220,879	1,765,010	1.45	.21
1919	30	614,190	1,043,111	1.70	.18
1920	33	640,690	1,672,190	2.61	.26
1921	19	617,790	1,107,530	1.79	.17
Utah:					
1916	2	720	1,200	1.67	4.48
1917					
1918	1	900	2,700	3.00	.63
1919	1	14,571	37,844	2.60	.57
1920	1	23,682	40,599	1.71	.32
1921	1	33,616	93,200	2.77	.74
Washington:					
1916	1	1,207	2,380	1.97	3.12
1917					
1918					
1919					
1920	1	8	25	3.13	1.04
1921	1	30	100	3.33	.19

[a] Partly estimated.

Sodium cyanide consumed at mills in certain Western States, 1916–1921, in pounds.[a]

State.	1916	1917	1918	1919	1920	1921
Arizona	216,841	157,381	157,204	99,605	219,569	293,597
Colorado	1,082,617	746,428	779,741	582,547	338,763	360,000
Idaho	700	3,728	15,600	950	1,600	11,391
Montana	190,249	158,215	83,542	64,900	105,874	108,665
Nevada	2,179,995	1,925,038	1,765,010	992,840	1,672,190	1,107,530
New Mexico	176,525	123,500	79,065	108,805	90,200	80,768
South Dakota	419,210	384,938	370,218	284,653	[b] 365,095	[b] 672,224
Texas	45,100	37,000	63,130	38,700	36,976	43,028
Utah		37,000	2,700	37,844	40,599	93,200
Washington	2,380					100
	4,313,617	3,573,228	3,316,210	2,210,844	2,870,866	2,770,503

[a] The consumption of potassium cyanide was 185,764 pounds in 1916, 137,658 pounds in 1917, 625 pounds in 1918, 68,155 pounds in 1919 (17,884 pounds at mills in Arizona and 50,271 pounds at mills in Nevada), 7,825 pounds in 1920 (7,800 pounds at mills in Arizona and 25 pounds at mills in Washington), and 5,626 pounds in 1921 (Arizona, 4,200 pounds, Idaho, 600 pounds, and South Dakota, 826 pounds).

[b] Includes some cyanamid (in 1921, 467,900 pounds of 48 per cent NaCn and 87,744 pounds of cyanamid).

It has not been possible to obtain figures showing the total consumption of potassium cyanide and sodium cyanide used in the recovery of gold and silver in the United States in 1921. If the quantity used in California, Alaska, and Oregon is added to the 2,776,129 pounds reported to have been used in other Western States, the total consumption was probably about 3,200,000 pounds.

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GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO.[1]

(MINES REPORT.)

By CHARLES W. HENDERSON.

PRODUCTION.

The total calculated gross value of the gold, silver, copper, lead, and zinc produced in New Mexico from ores and gravels in 1921 decreased nearly 79 per cent from the value in 1920. There were 49 producing mines, of which 40 were deep and 9 placers, a decrease of 53 deep mines and an increase of 3 placers.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1920–1921.

Year.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Zinc.	Total value.
	Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	2,250,718	$480,302	768,042	54,400,691	2,869,525	10,013,580	$12,367,857
1921	611,576	196,822	571,899	14,267,338	678,601	228,000	2,651,145
Decrease, 1921	1,639,142	283,480	196,143	40,133,353	2,190,924	9,785,580	9,716,712

[a] Includes placer production.

ORE.

The bullion derived from 52,220 tons of ore treated in 1921 at amalgamating and cyaniding mills in New Mexico amounted to $126,004 in gold, or $2.41 a ton, and 253,719 ounces of silver, valued at $253,719, or 4.86 ounces a ton. The bullion recovered per ton of ore treated in 1920 was $4.08 in gold and $5.99 in silver.

GOLD.

The gold recoverable from ores and gravels mined in New Mexico in 1921 amounted to 9,521.26 fine ounces, valued at $196,822. Catron County produced 64 per cent of the total, Hidalgo County 12 per cent, Grant County nearly 9 per cent, and Lincoln, Otero, and Taos combined 8 per cent. Dry and siliceous ores yielded 88 per cent of the total.

SILVER.

The silver recoverable from ores and gravels mined in New Mexico in 1921 amounted to 571,899 fine ounces, valued at $571,899. Of the total quantity Catron County produced 54 per cent, from the siliceous

[1] For reports on geology and description of mines, see Lindgren, Graton, and Gordon, The ore deposits of New Mexico. U. S. Geol. Survey Prof. Paper 68, 1910; also Finlay, J. R., Report of appraisal of mining properties of New Mexico to tax commissioners, Santa Fe, N. Mex., 1921–22.

ore of the Mogollon district; Grant County nearly 19 per cent, chiefly from Gold Hill, Chloride Flat, Burro Mountain, and Central districts; Sierra County nearly 14 per cent, chiefly from Lake Valley and Kingston districts, and Hidalgo County 11 per cent from Lordsburg, Eureka, and Steins districts. Placer mines yielded 61 ounces of silver.

Dry and siliceous gold and silver ores, chiefly from Catron, Grant, Hidalgo, and Sierra counties, yielded 85 per cent; lead ores 10 per cent chiefly from Grant and Hidalgo counties; and copper ores, chiefly from Grant County, yielded 4 per cent.

COPPER.

The recoverable copper in the ores mined in New Mexico in 1921 amounted to 14,267,338 pounds, valued at $1,840,487. Grant and Hidalgo counties, chiefly from the Chino Copper Co.'s three months operation, but also from the Burro Mountain and Lordsburg districts, produced 99.6 per cent of the total. Copper ores, chiefly from Grant County, yielded 96 per cent of the total.

LEAD.

The recoverable lead in the ores mined in New Mexico in 1921 amounted to 678,601 pounds, valued at $30,537. The principal lead-producing districts were the Gallinas Mountains district, Lincoln County, the Victorio district, Luna County, the Eureka district, Hidalgo County, the Gold Hill district, Grant County, and the Magdalena district, Socorro County.

ZINC

The total zinc recoverable from ores mined in New Mexico in 1921 amounted to 228,000 pounds, valued at $11,400. Small shipments of zinc ore were made from the Hanover and the Magdalena districts.

OUTPUT OF ORE AND METAL CONTENT.

Ores and metals produced in New Mexico in 1921.

Source.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Dry gold ore	1,359	941.86	210	73	.....	.....
Dry gold and silver ore	2,000	110.63	3,481	.....	.....	.....
Dry silver ore	71,379	7,337.34	483,712	580,377	61,960	.....
Copper ore	533,231	630.01	24,489	13,637,034	.....	.....
Copper-lead ore	378	.....	2,552	49,240	155,222	.....
Lead ore	2,514	100.83	57,394	614	417,419	.....
Lead-zinc ore	351	.....	.....	.....	44,000	112,000
Zinc ore	364	.....	.....	.....	.....	116,000
	611,576	9,120.67	571,838	14,267,338	678,601	228,000
Placers	.....	400.59	61	.....	.....	.....
	611,576	9,521.26	571,899	14,267,338	678,601	228,000

Metallic content of ores sold or treated in New Mexico in 1921.

Dry and siliceous gold and silver ores.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
GOLD ORES.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Colfax	.....	259.34	33	.....	.....
Grant	50	35.10	12	.....	.....
Lincoln	800	364.41	132	.....	.....
Otero	500	253.00	32	.....	.....
Sierra	9	30.01	1	73	.....
	1,359	941.86	210	73	.....
GOLD AND SILVER ORES.					
Taos	2,000	110.63	3,481	.....	.....
SILVER ORES.					
Catron	48,870	6,133.51	310,774	.....	.....
Grant	6,794	41.83	45,664	1,161	42,355
Hidalgo	11,971	1,128.01	52,822	578,508	5,317
Sierra	3,744	33.99	74,452	708	14,288
	71,379	7,337.34	483,712	580,377	61,960

Copper ores.

Grant	533,165	619.01	23,771	13,633,402	.....
Hidalgo	66	11.00	718	3,632	.....
	533,231	630.01	24,489	13,637,034	.....

Copper-lead ores.

Lincoln	378	.....	2,552	49,240	155,222

Lead ores.

Dona Ana	47	.....	676	.....	20,000
Grant	520	24.85	36,788	.....	54,489
Hidalgo	1,142	4.00	12,153	.....	155,106
Luna	676	71.98	4,709	.....	144,467
Sierra	103	.....	2,913	614	26,646
Socorro	26	.....	155	.....	16,711
	2,514	100.83	57,394	614	417,419

Zinc ores.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Grant	329	.....	.....	.....	.....	95,000
Socorro	35	.....	.....	.....	.....	21,000
	364	.....	.....	.....	.....	116,000

Lead-zinc ores.

Socorro	351	.....	.....	.....	44,000	112,000

PLACER OUTPUT.

Placer output in New Mexico in 1921.

County.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		
Colfax	166.75	$3,447	19	$19	$3,466
Grant	114.55	2,368	37	37	2,405
Santa Fe	119.29	2,466	5	5	2,471
Total, 1921	400.59	8,281	61	61	8,342
Total, 1920	105.84	2,188	20	22	2,210
Increase, 1921	294.75	6,093	41	39	6,132

SMELTERS.

The only smelter in operation in New Mexico in 1921 was the zinc oxide plant at Waldo, near Cerrillos. Smelters receiving ore from New Mexico were the lead and copper plants of the El Paso Smelting Works at El Paso, Tex.; the Copper Queen copper smelter and the Calumet & Arizona copper smelter at Douglas, Ariz.; and the Ozark zinc-lead oxide plant at Coffeyville, Kans.

MINING INDUSTRY.

The features in mining industry of New Mexico in 1921 were the closing of the mines of the Chino Copper Co., of the Burro Mountain Branch of the Phelps Dodge Corporation, and of the Graphic Waldo (at Magdalena) in March; the decreased production from Lordsburg; the idleness of the Aztec gold mine, at Baldy; the lessened production from Sierra County mines; the idleness of nearly all the zinc mines; the reopening of the Volcano mine, at Steins; the maintenance of production at Mogollon; the new production of gold from Nogal; the renewal of production at Orogrande; and the production of silver from Gold Hill, Hachita, and Chloride Flat (Silver City).

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1921, by counties.

County.	Number of mines producing.	Ore (short tons).	Gold.[a]		Silver.[a]	
			Fine ounces.	Value.	Fine ounces.	Value.
Catron	2	48,870	6,133.51	$126,791	310,774	$310,774
Colfax	4	.....	426.09	8,808	52	52
Dona Ana	1	47	.....	.....	676	676
Grant	14	540,858	835.34	17,268	106,272	106,272
Hidalgo	7	13,179	1,143.01	23,628	65,693	65,693
Lincoln, Otero, and Taos [b]	5	3,678	728.04	15,050	6,197	6,197
Luna	3	676	71.98	1,488	4,709	4,709
Santa Fe	4	.....	119.29	2,466	5	5
Sierra	8	3,856	64.00	1,323	77,366	77,366
Socorro	1	412	.....	.....	155	155
Total, 1921	49	611,576	9,521.26	196,822	571,899	571,899
Total, 1920	99	2,250,718	23,234.61	480,302	768,042	837,166
Decrease, 1921	50	1,639,142	13,713.35	283,480	196,143	265,267

[a] Includes placer production.
[b] In order to avoid disclosing individual figures, the production of Lincoln, Otero, and Taos counties is combined.

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1921, by counties—Continued.

County.	Copper.		Lead.		Zinc.		Total value.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
Catron							$437,565
Colfax							8,860
Dona Ana			20,000	$900			1,576
Grant	13,634,563	$1,758,859	96,844	4,358	95,000	$4,750	1,891,507
Hidalgo	582,140	75,096	160,423	7,219			171,636
Lincoln, Otero, and Taos [b]	49,240	6,352	155,222	6,985			34,584
Luna			144,467	6,501			12,698
Santa Fe							2,471
Sierra	1,395	180	40,934	1,842			80,711
Socorro			60,711	2,732	133,000	6,650	9,537
Total, 1921	14,267,338	1,840,487	678,601	30,537	228,000	11,400	2,651,145
Total, 1920	54,400,691	10,009,727	2,869,525	229,562	10,013,580	811,100	12,367,857
Decrease, 1921	40,133,353	8,169,240	2,190,924	199,025	9,785,580	799,700	9,716,712

Gold and silver produced at mills in New Mexico, 1920–1921.

Year.	Ore to gold and silver mills.	Gold in bullion.	Silver in bullion.	Ore to concentrating mills.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
1920	49,393	9,749.05	271,294	2,118,694
1921	52,220	6,095.43	253,719	534,665
Increase or decrease, 1921	+2,827	−3,653.62	−17,575	−1,584,029

Mine production of metals from New Mexico crude ore shipped to smelters, 1921, by counties.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Dona Ana	47		676		20,000	
Grant	6,143	59.85	73,536	1,161	77,844	95,000
Hidalgo	13,179	1,143.01	65,693	582,140	160,423	
Lincoln	378		2,552	49,240	155,222	
Luna	676	71.98	4,709		144,467	
Sierra	3,856	64.00	77,366	1,395	40,934	
Socorro	412		155		60,711	133,000
	24,691	1,338.84	224,687	633,936	659,601	228,000

Mine production of metals from New Mexico crude ore shipped to smelters, 1920–1921.

Year.	Crude ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
1920	82,631	8,556.61	357,567	3,818,711	2,787,575	2,469,777
1921	24,691	1,338.84	224,687	633,936	659,601	228,000
Decrease, 1921	57,940	7,217.77	132,880	3,184,775	2,127,974	2,241,777

Mine production of metals from New Mexico concentrates, 1920–1921.

Year.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
1920	180,022	4,823.11	139,161	50,581,980	81,950	7,543,803
1921	40,549	1,686.40	93,432	13,633,402	19,000	.....
Decrease, 1921	139,473	3,136.71	45,729	36,948,578	62,950	7,543,803

Mine production of metals from New Mexico crude ore and concentrates combined, shipped to smelters, 1920–1921.

Year.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
1920	262,653	13,379.72	496,728	54,400,691	2,869,525	10,013,580
1921	65,240	3,025.24	318,119	14,267,338	678,601	228,000
Decrease, 1921	197,413	10,354.48	178,609	40,133,353	2,190,924	9,785,580

Gold and silver contained in bullion produced at mills in New Mexico, 1921.

Process.	Ore.	Gold in bullion.	Silver in bullion.	Quicksilver used.	Sodium cyanide used.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Amalgamation	1,350	911.85	209	130	.....
Cyanidation	50,870	5,183.58	253,510	.....	80,768
	52,220	6,095.43	253,719	130	80,768

REVIEW BY COUNTIES.

CATRON COUNTY.[2]

Mogollon (Cooney) district.—The Mogollon district in 1921 produced 48,870 tons of ore, which yielded $126,791 in gold and 310,774 ounces of silver, as compared with 41,895 tons, $125,631 in gold, and 329,489 ounces of silver in 1920.

The Mogollon Mines Co.'s 40-stamp cyanidation and concentration mill was operated continuously on ore from the Last Chance, Top, Dutch Boy, Black Bird, Confidence, and Deadwood mines. The Fanney mill remained idle.

COLFAX COUNTY.

Elizabethtown district (including Baldy).—Several lots of specimen gold from the Aztec mine (company work ceased June, 1920), were shipped to the Denver Mint by lessees. The Lowrey placer, at Elizabethtown, and placer ground on Willow Creek continued to yield bullion. The Aztec mill was idle but diamond drilling and drifting were done in search for ores at the mine. Some development work was done at the Ajax mine.

[2] This county was separated from Socorro County at the legislative session in the spring of 1921. Officers took their seats July 1, 1921.

DONA ANA COUNTY.

The only shipment made from the Organ Mountain district consisted of one car of lead-silver ore sent from the Bennett-Stephenson mine. All other properties were idle. Early in 1921 the Hembrillo Copper Mining & Milling Co., in the San Andres Mountains district, cleaned its 1,600-foot adit, drove 50 feet, and did some core drilling.

GRANT COUNTY.

Burro Mountain district.—The Burro Mountain Branch of the Phelps Dodge Corporation operated its mine and 2,000-ton table-concentration and oil-flotation mill from January 1 to March 31, when all work ceased for the year.

Central district.—Very little output was made in the Central district, except from the Santa Rita mines of the Chino Copper Co., which operated its 12,000-ton table and vanners-concentration and oil-flotation mill, at Hurley, at the rate of 3,546 tons a day from January 1 to April 12. The small output in April, 1921, was only that from concentrates produced during the time required to clean up and shut down the mill. The twelfth annual report of the company, for the year ending December 31, 1921 (dated April 15, 1922), says:

> There was no development or prospect drilling carried on at the mine during the year. There were no additions to the mining property during the year.
>
> A recalculation of ore reserves was completed as of January 1, 1921, and fully discussed in the eleventh annual report. The removal of ore ceased with a few shifts in the month of April, 1921, and there remained as ore reserves at the mine, using the calculation previously referred to, 103,462,552 tons of an average grade of 1.53 per cent copper, and, in addition to the unmined reserve, 1,834,444 tons of ore averaging 1.41 per cent copper in the stock piles at Santa Rita, and 88,465 tons in a special reserve used for experimental purposes, averaging 1.37 per cent copper. The total ore, therefore, unmined or untreated, at the end of the year 1921 is 105,385,461 tons, of an average grade of 1.53 per cent copper.
>
> The total ore developed by churn drilling to date, including the ore removed to the close of operations in April, 1921, is 127,335,159 tons, of an average grade of 1.58 per cent copper.
>
> No additional equipment was purchased nor were any improvements made in the surface arrangements at the mine during the year.
>
> Mining operations were discontinued on April 8 and were not resumed during the year. The total ore and waste removed by steam shovels during the year to the date of cessation of operations was 657,398 cubic yards. Of this amount 477,903 cubic yards were stripping, the remainder being equivalent to 349,071 tons of ore. Of this ore 303,786 tons was sent to the mill and 45,285 tons to the stock piles.
>
> From the beginning of steam-shovel operations, September 23, 1910, there has been removed a total of 42,219,810 cubic yards of material, of which 30,025,174 cubic yards was capping, the remainder being equivalent to 23,868,902 tons of ore. Of this total 21,918,449 tons of ore was shipped to the mill and 27,544 tons went direct from the mine to the smelter. The balance of the ore extracted remains in stock piles and reserve inventory, as previously stated.
>
> No new construction or alterations were made in the mill during the year.
>
> Actual milling operations ceased on April 12; the last car of concentrates being shipped on April 15. There was treated for the period operated in 1921 a total of 361,660 dry tons of ore. For the 102 days operated this was an average of 3,546 tons per day, compared to an average of 5,022 tons per day for the year 1920. The average copper content of the ore treated during the period was 1.70 per cent, or approximately 0.06 per cent lower than that treated for the year 1920. The total production of concentrates amounted to 22,248 dry tons, which averaged 21.36 per cent copper, corresponding to a recovery of 26.28 pounds of copper per ton of ore, equivalent to an extraction of 77.36 per cent. The extraction stated is slightly higher than the average reported for the first quarter, due to the cleaning up of residual concentrates in various apparatus in the mill, the ore treated for the first quarter during the regular operations

showing an extraction of 76.36 per cent, or approximately 5.69 per cent higher than for the year 1920.

The average cost of milling was, for the period operated, $1.37 per ton, which is an increase, compared to the cost for 1920, of 15 cents per ton. This increase is due to the decreased tonnage handled, in spite of the decrease in wages made effective during this period. The operating costs on the very small tonnage milled during the first few days of April had a decided effect in raising the general average for the whole period under consideration.

The production of copper as contained in concentrates (and there were no other shipping products during the year) was 9,504,601 pounds, as compared to a production for the year 1920 of 46,088,609 pounds. After allowing for smelter deductions the net output of refined copper for the year was 9,137,282 pounds.

No production was made from the Empire Zinc Co.'s Hanover mines. Experimental work was done at the mill. Some low-grade zinc carbonate ore was shipped from the Bond-Pewabic mine at Hanover to the zinc oxide plant at Waldo. Several cars of silver ore were shipped from the Georgetown group.

Chloride Flat district.—Lessees on the Baltic, Tight Squeeze, Providencia, and Grand Central claims, shipped several thousand tons of silver ore, in a lime gangue, with 4 per cent of iron, 2 per cent of manganese, and 2 per cent of silica. No manganese ore was shipped to steel mills from this district in 1921.

Gold Hill district.—The development work of 1920 at the Good Luck property (14 miles from Lordsburg), by the Co-Operative Mining Co., resulted in the shipment in 1921 of several hundred tons lead-silver ore of very good grade and of several cars of lead-silver concentrate from the 80-ton oil flotation mill. Oxidized gold ore from the Standard (or Cline) mine was treated in the 2-stamp amalgamation mill on the property.

Lone Mountain district (near Hurley).—One car of ore was shipped in 1921 from the surface discovery of silver ore made in 1920 in the Lone Mountain district.

Pinos Altos district.—No production was made from deep mines in the Pinos Altos district. Placer mines produced 114.55 fine ounces of gold, and 37 ounces of silver, an appreciable increase over 1920.

Steeplerock district.—Several cars of silver ore were shipped from the Norman King group, and a small lot of gold ore from the Free Gold claim was reduced to bullion.

White Signal district.—Assessment work only was done in the White Signal district.

HIDALGO COUNTY.[3]

Eureka (Hachita) district.—A large quantity of lead-silver ore was shipped from the American mine, and several cars of silver ore were shipped from the King 400 mine.

Lordsburg district (including Pyramid and Virginia or Shakespeare districts.)—The production of the Lordsburg district was the smallest since 1909. Only 11,593 tons of ore were marketed in 1921, compared with 55,307 tons in 1920. Development was continuous at the Eighty-Five mine, but shipments of gold-silver-copper ore, with high silica content, of value to the copper smelters, was greatly lessened by the curtailment of operations at the Douglas, Ariz., smelters. Several cars of copper ore from the Atwood, and a car of silver ore from the Last Chance were shipped to smelters at El Paso

[3] For review of districts prior to 1920, see Grant County.

and Douglas. Much development work was done at the Last Chance mine and construction of a new 50-ton concentration mill was begun.

Steins district.—The Volcano mine was reopened and several hundred tons of silver ore were shipped during the last quarter of the year from the Steins district.

LINCOLN COUNTY.

Nogal district.—Development work, begun in 1920 and continued throughout 1921, included a three months' test run in 1921 at the Helen Rae mine of the 5-stamp amalgamation gravity-concentration mill with production of gold-silver bullion. The concentrate was not marketed. Development work was done on the Maud E property during three months of the year.

Red Cloud (Gallinas Mountains) district.—Several hundred tons of lead-copper-silver ore was shipped to El Paso from the Red Cloud mine after October, 1921. Development in 1921 consisted in sinking the shaft from the 100-foot level to 200 feet and in crosscutting to the vein.

Whiteoaks district.—The Homestake amalgamation mill, with a record of small but continuous production of gold bullion for many years, was idle in 1921.

LUNA COUNTY.

Cooks Peak district.—No ore was shipped from the Cooks Peak district, until 1919 a contributor of appreciable quantities of lead and zinc ores.

Victorio (Gage) district.—Several hundred tons of lead-silver ore were shipped during the year from the Excess mine, and several cars of lead-silver ore were shipped from the Chance group in January before closing.

OTERO COUNTY.

Orogrande district.—The milling operations begun in 1920, including the use of a crusher, Huntington mill, and amalgamating plates, on ores from the Little Annie and Nannie Baird properties, were continued for about nine months in 1921 and resulted in a product of gold bullion, containing some silver. Iron ores were shipped from the Orogrande district to the Pueblo, Colo., steel plant until September, from the Cinco de Mayo, Iron Duke, Lincoln, Seven-Come-Eleven, and Three Bears claims. A jigging plant for concentrating the finely divided iron ores of the Lincoln and Seven-Come-Eleven claims was operated during the year. Coarse iron ore was shipped without treatment.

Corona district.—Iron ores were shipped during the spring of 1921 from the Beeth Bros. property to the Pueblo, Colo., steel plant.

High Rolls district.—Lessees were engaged in diamond drilling and drifting at the Alamo group until February 15, 1921, when the option on the property was dropped.

SAN MIGUEL COUNTY.

Examination work, begun in 1918 and continued in 1919 and 1920, with development work, continued at the Pecos mines, at the junction of Willow Creek and Pecos River.

SANTA FE COUNTY.

Cerrillos district.—None of the mines in the Cerrillos district were operated in 1921. The Grubnau zinc oxide plant, at Waldo, was operated part of the year.

New Placers (Golden) district.—Small quantities of specimen gold and placer gold were shipped to the Denver Mint. Development continued at the Amazon-Anaconda-Lincoln group of the Collier Mines Co.

SIERRA COUNTY.

Sierra County's production in 1921 decreased nearly 50 per cent from that of 1920.

Chloride (Apache, Cuchillo Negro) district.—Several cars of silver ore were shipped from the Egypt and a small lot of gold ore from the McKinley property. Construction of a 50-ton table-concentration and oil-flotation mill was begun at the Silver Monument mine.

Hillsboro (Las Animas) district.—Assessment work only was done in the Hillsboro district in 1921.

Kingston district.—Work was continuous at the Lady Franklin mine, from which several cars of silver ore were shipped. A car of silver ore was shipped from the Illinois-Saratoga group, upon which very little development was done in 1921.

Lake Valley district.—From the Lake Valley mine, an appreciable quantity of highly siliceous ore was shipped to El Paso for use in the copper plant in smelting copper concentrates until March 30, when the closing of the Chino Copper Co.'s mill closed the El Paso copper plant. Beginning in September, iron-manganese-silver ore was shipped from the Lake Valley mine for use in fluxing at the lead plant at El Paso.

Pittsburg district (Caballos Mountains.)—Development work was done at the Marion mine.

SOCORRO COUNTY.

Magdalena (Kelly) district.—The only mine operating in the Magdalena district was the Graphic-Waldo, and it was closed in March. Shipments in January and February were small, consisting chiefly of lead-zinc ore to the zinc oxide plant at Coffeyville, Kans.

TAOS COUNTY.

Red River district.—The Caribel cyanidation mill was overhauled and operated 90 days in testing the ore of the Caribel mine, the product being silver-gold bullion. On the Silver King property, the drainage adit was continued to 1,130 feet.

SILVER AND COPPER IN TEXAS.

(MINES REPORT.)

By Charles W. Henderson.

Mine production of silver and copper in Texas, 1920–21.

Year.	Silver.		Copper.		Total value.
	Fine ounces.	Value.	Pounds.	Value.	
1920	511,401	$557,427	14,435	$2,656	$560,083
1921	355,109	355,109			355,109
Decrease, 1921	156,292	202,318	14,435	2,656	204,974

Presidio County.—The quantity of silver bullion produced at the 125-ton cyanidation mill of the Presidio mine, Shafter district, was less in 1921 than in 1920. Since the beginning of mining in Texas, in 1885, this mine has produced the greater part of the State's silver output, which is 15,648,843 fine ounces, having a commercial value of $11,280,242.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO.

(MINES REPORT.)

By Charles W. Henderson.

PRODUCTION.

The total calculated gross value of the gold, silver, copper, lead, and zinc produced in Colorado in 1921 showed a decrease of 36 per cent from the gross value in 1920. All five metals showed decrease in gross value, but $6,679,712 of the total decrease of $7,893,474 was in the value of lead and zinc.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1920–21.[a]

Year.	Number of producing mines.	Ore.	Gold.		Silver.[b]	Copper.	Lead.	Zinc.	Total value.
			Placer.	Deep.					
		Short tons.			*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1920	416	1,571,293	$514,588	$7,061,731	5,409,335	4,043,734	46,629,788	48,790,742	$21,898,974
1921	382	1,281,381	344,640	6,490,688	5,631,657	4,153,442	19,660,466	2,360,000	14,005,500
Increase or decrease, 1921	−34	−289,912	−169,948	−571,043	+222,322	+109,708	−26,969,322	−46,430,742	−7,893,474

[a] A revised table showing the production of gold, silver, copper, lead, and zinc from the beginning of mining in Colorado to 1921 will be included in a professional paper, "The history and development of mining in Colorado, 1859–1921," now in preparation.

[b] Includes placer production.

ORE.

In 1921 amalgamating and cyaniding mills, with or without concentration equipment (including all the custom mills of the State), treated 884,763 short tons of ore and recovered in bullion and precipitates an average of 0.247 ounce of gold and 0.059 ounce of silver to the ton. Besides this ore, 206,270 tons was sent to concentration and separation mills. The total quantity of ore sent to mills of both classes, 1,091,033 tons, was 85 per cent of the total quantity treated, as against 83 per cent of the total quantity treated in 1920. From this total quantity 49,140 tons of concentrates was produced, the ratio of concentrates to ore being 22 to 1 in 1921 as compared with 11 to 1 in 1920. This increase in the ratio of concentration indicates that year by year ore of lower grade is being treated in Colorado, but the greater ratio in 1921 was due in fact to the

decrease in the quantity of lead-zinc ores concentrated, for the ratio of lead, zinc, and iron concentrates to the crude ore is low as compared with the ratio of gold and silver concentrates to the crude ore. The effect of this condition is seen in the almost anomalous shortage of silica for fluxing in ores brought to Colorado smelters from Colorado mines, much siliceous ore being brought in from mines in Utah and iron ores being in turn sent from Colorado to smelters in Utah. In 1921 the lead concentrates contained 10,225,992 pounds of lead, whereas in 1920 they contained 20,871,928 pounds. The concentrates of all other classes contained only small quantities of lead in 1921, and the smelting ores contained only 9,236,055 pounds of lead in 1921 as compared with 17,586,661 pounds in 1920.

GOLD.

The mine production of gold in Colorado in 1921 was 330,658.99 fine ounces valued at $6,835,328, a decrease of 35,845.44 fine ounces and of $740,991 in value, following decreases of $2,310,308 in 1920 and $2,865,091 in 1919.

The Cripple Creek district had the smallest output since 1894, but it furnished nearly 63 per cent of the State yield in 1921. The San Juan region, of Dolores, La Plata, Ouray, San Juan, and San Miguel counties, yielded $1,597,358, a decrease for the region of $56,781. There were increases of $39,227 in Eagle County, $34,161 in La Plata, $39,452 in Ouray, and $128,594 in San Miguel, and decreases of $51,859 in Gilpin, $459,221 in Lake, $101,908 in Park, $258,494 in San Juan, and $46,474 in Summit.

The output of placer gold in 1921 was $344,640, a decrease of $169,948. Summit County, with 2 dredges, 3 sluice mines, and 2 hydraulic mines, produced 98 per cent of the placer gold; Lake County, with 1 dredge and 3 sluice mines, produced nearly 2 per cent; and the remainder was produced by hydraulicking and sluicing in Douglas and Park counties.

SILVER.

The output of silver in Colorado in 1921 was valued at $5,631,657, a decrease of $264,518. The greatest increases in production were made in Eagle, Ouray, and San Miguel counties.

COPPER.

The output of copper in 1921 was valued at $535,794, a decrease of $208,253.

Eagle County produced 44 per cent of the copper output, Lake County 27 per cent, and San Miguel County 22 per cent.

LEAD.

The lead produced in Colorado in 1921, reckoned as lead in lead bullion and in leaded-zinc oxide, was valued at $884,721, a decrease of $2,845,662.

There were decreases in all counties except La Plata, Saguache, San Miguel, and Summit counties in quantity, and in all except La Plata in value.

San Miguel was first in rank, and was followed in order by Lake, Pitkin, Ouray, Clear Creek, and Park. There was a large decrease in the quantity and the lead content of the lead ores produced as well as in the quantity of lead-zinc ores.

ZINC.

In 1921 the zinc ores marketed from Colorado contained recoverable zinc valued at only $118,000, a decrease of $3,834,050.

Lake County produced 77 per cent of the zinc output of the State, as compared with 38 per cent in 1920 and 62 per cent in 1919. Leadville shipments of zinc carbonate ore amounted to 4,277 tons, carrying 17.97 per cent of zinc, and zinc sulphide ores sold or treated in Leadville amounted to 1,292 tons, carrying 29.38 per cent of zinc.

OUTPUT OF ORE AND METAL CONTENT.

Ore and metals produced in Colorado in 1921.

Source of production.	Ore.		Gold.		Silver.	
	Short tons.	*Per cent.*	*Fine ounces.*	*Per cent.*	*Fine ounces.*	*Per cent.*
Dry gold ore	495,853	38.70	221,292.06	66.92	81,157	1.44
Dry gold and silver ore	269,087	20.99	53,991.30	16.33	589,284	10.47
Dry silver ore	465,232	36.31	31,733.60	9.60	3,991,193	70.87
Total dry ores	1,230,172	96.00	307,016.96	92.85	4,661,634	82.78
Copper ore	22,195	1.73	1,811.24	.55	382,521	6.79
Copper-lead ore	820	.06	24.60	.01	40,949	.73
Lead ore	18,289	1.43	5,089.73	1.54	524,023	9.30
Lead-zinc ore	4,178	.33	30.60	.01	14,851	.26
Zinc ore	5,727	.45	13.91	.....	3,237	.06
Total all other ores	51,209	4.00	6,970.08	2.11	965,581	17.14
Total, deep mines	1,281,381	100.00	313,987.04	94.96	5,627,215	99.92
Total, placers	.....	.....	16,671.95	5.04	4,442	.08
Total, deep and placers, 1921	1,281,381	100.00	330,658.99	100.00	5,631,657	100.00
Total, deep and placers, 1920	1,571,293	.....	366,504.43	.....	5,409,335	.....
Increase or decrease, 1921	−289,912	.....	−35,845.44	.....	+222,322	.....

Source of production.	Copper.		Lead.		Zinc.	
	Pounds.	*Per cent.*	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*
Dry gold ore	54,359	1.31	119,140	0.60	.....	.....
Dry gold and silver ore	891,660	21.47	3,409,026	17.34	.....	.....
Dry silver ore	1,882,519	45.32	10,561,401	53.72	.....	.....
Total dry ores	2,828,538	68.10	14,089,567	71.66	.....	.....
Copper ore	1,164,248	28.03	10,522	.06	.....	.....
Copper-lead ore	78,448	1.89	184,221	.94	.....	.....
Lead ore	81,260	1.96	4,851,872	24.68	.....	.....
Lead-zinc ore	948	.02	456,720	2.32	483,000	20.47
Zinc ore	.....	.....	67,564	.34	1,877,000	79.53
Total all other ores	1,324,904	31.90	5,570,899	28.34	2,360,000	100.00
Total, deep mines, 1921	4,153,442	100.00	19,660,466	100.00	2,360,000	100.00
Total, deep mines, 1920	4,043,734	.....	46,629,788	.....	48,790,742	.....
Increase or decrease, 1921	+109,708	.....	−26,969,322	.....	−46,430,742	.....

Placer output in Colorado in 1921, in fine ounces.

County.	Sluice and hydraulic.		Dredges.		Total.	
	Gold.	Silver.	Gold.	Silver.	Gold.	Silver.
Douglas	2.27				2.27	
Lake	9.60		289.55	80	299.15	80
Park	20.75	4			20.75	4
Summit	291.01	92	16,058.77	4,266	16,349.78	4,358
Total, 1921	323.63	96	16,348.32	4,346	16,671.95	4,442
Total, 1920	82.81	22	24,810.39	6,694	24,893.20	6,716
Increase or decrease, 1921	+240.82	+74	−8,462.07	−2,348	−8,221.25	−2,274

Content of dry gold ores sold or treated in Colorado in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Boulder	662	1,173.17	1,192		500	
Clear Creek	2,137	850.67	2,571	11,166	7,517	
Costilla		2.52				
Custer	97	4.30	2,601		3,374	
Eagle	36	60.20	291	468		
Gilpin	2,468	1,569.36	3,850	8,282	7,987	
Gunnison	425	875.46	6,034		6,275	
Hinsdale	41	119.78	914		721	
Lake	2,649	5,269.98	16,336	23,182	39,055	
La Plata	417	680.73	780			
Ouray	2,505	1,524.39	6,501	9,560	45,511	
Park	69	315.13	238	574	5,402	
San Juan	3	34.38	7			
San Miguel	133	1,128.43	2,480	1,127	2,798	
Summit	100	63.72	27			
Teller	484,110	207,619.84	37,335			
Total, 1921	495,853	221,292.06	81,157	54,359	119,140	
Total, 1920	505,885	246,061.02	187,181	358,034	715,357	77,635
Decrease, 1921	10,032	24,768.96	106,024	303,675	596,217	77,635

Content of dry gold and silver ores sold or treated in Colorado in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Shorttons.	*Fincounces.*	*Fineounces.*	*Pounds.*	*Pounds.*
Boulder	1,088	205.81	3,812		5,718
Clear Creek	487	184.54	2,699	1,040	13,890
Eagle	11	11.20	173	207	
Gilpin	89	67.95	884	214	751
Lake	6,891	5,033.80	92,056	217,425	135,648
La Plata	823	1,493.20	17,427		890
San Miguel	259,624	46,953.70	470,949	672,774	3,248,313
Summit	74	41.10	1,284		3,816
Total, 1921	269,087	53,991.30	589,284	891,660	3,409,026
Total, 1920	366,297	62,173.38	952,257	1,055,118	8,981,473
Decrease, 1921	97,210	8,182.08	362,973	163,458	5,572,447

Content of dry silver ores sold or treated in Colorado in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Shorttons.	*Fineounces.*	*Fineounces.*	*Pounds.*	*Pounds.*
Boulder	11,230	222.41	79,839	.....	97,526
Chaffee	1,828	1,332.18	22,848	3,855	155,083
Clear Creek	25,346	615.48	79,560	4,442	483,749
Dolores	372	89.78	14,309	670	15,805
Eagle	17,684	1,369.59	306,172	704,585	4,702
Gilpin	727	39.79	4,921	.....	18,917
Gunnison	20	5.60	3,415	.....	1,636
Hinsdale	261	17.30	17,584	2,097	11,334
Lake	60,843	2,242.41	859,029	866,688	2,119,493
La Plata	39	11.70	2,120	.....	2,844
Mineral	6,814	54.80	186,239	1,899	100,840
Ouray	66,378	2,000.06	665,600	36,712	950,114
Park	2,786	6.59	20,825	1,679	86,217
Pitkin	53,770	.....	358,517	233	1,580,321
Saguache	5,975	70.08	67,972	11,605	69,150
San Juan	45	20.50	3,568	993	2,037
San Miguel	194,248	22,767.83	1,207,424	220,226	4,455,432
Summit	16,866	867.50	91,251	26,835	406,201
Total, 1921	465,232	31,733.60	3,991,193	1,882,519	10,561,401
Total, 1920	351,899	6,893.30	2,497,880	831,728	7,002,932
Increase, 1921	113,333	24,840.30	1,493,313	1,050,791	3,558,469

Content of copper ores sold or treated in Colorado in 1921.[a]

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Shorttons.	*Fineounces.*	*Fineounces.*	*Pounds.*	*Pounds.*
Eagle	22,054	1,689.99	375,914	1,127,818	7,876
Gilpin	50	107.66	704	3,411	1,832
Ouray	61	.20	4,237	31,036	.....
Park	15	7.69	744	1,298	.....
Saguache	8	.20	451	291	814
San Juan	7	5.50	471	394	.....
Total, 1921	22,195	1,811.24	382,521	1,164,248	10,522
Total, 1920	3,835	2,150.54	100,643	383,427	41,937
Increase or decrease, 1921	+18,360	−339.30	+281,878	+780,821	−31,415

[a] All smelting ore.

Content of lead-copper ores sold or treated in Colorado in 1921.[a]

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Custer	449	4.10	16,035	37,690	98,127
Hinsdale	24	2.00	3,220	2,020	4,655
Saguache	298	16.50	19,861	35,297	66,991
San Juan	49	2.00	1,833	3,441	14,448
Total, 1921	820	24.60	40,949	78,448	184,221
Total, 1920	453	173.47	7,566	30,865	184,011
Increase or decrease, 1921	+367	−148.87	+33,383	+47,583	+210

[a] All smelting ore.

Content of lead ores sold or treated in Colorado in 1921.[a]

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Boulder	196	45.39	28,114	302	36,592
Chaffee	493	217.47	4,793	4,502	163,583
Clear Creek	1,004	196.52	33,683	3,923	339,899
Custer	22	.50	555	.....	4,521
Dolores	14	.....	190	74	2,819
Gilpin	219	131.37	7,604	1,279	62,157
Gunnison	53	.48	921	.....	44,044
Hinsdale	169	26.60	10,321	5,240	49,046
Lake	4,522	2,097.20	73,477	.....	1,179,285
Mineral	262	129.80	6,229	.....	55,938
Ouray	287	17.80	54,632	7,731	212,774
Park	2,059	1,645.31	25,736	3,999	562,471
Pitkin	6,271	.....	113,493	.....	711,301
Saguache	131	3.00	2,587	2,319	61,731
San Juan	1,060	337.78	58,300	23,730	541,076
San Miguel	1,276	204.21	96,110	27,446	729,701
Summit	251	36.30	7,278	715	94,940
Total, 1921	18,289	5,089.73	524,023	81,260	4,851,872
Total, 1920	61,254	11,459.90	841,783	235,177	11,892,212
Decrease, 1921	42,965	6,370.17	317,760	153,917	7,040,340

[a] Nearly all smelting ore.

Content of lead-zinc ores sold or treated in Colorado in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Clear Creek	3,743	30.60	12,636	948	352,720	200,000
Pitkin	435	.....	2,215	.....	104,000	283,000
Total, 1921	4,178	30.60	14,851	948	456,720	483,000
Total, 1920	185,438	12,144.71	726,472	1,109,381	16,105,887	15,256,850
Decrease, 1921	181,260	12,114.11	711,621	1,108,433	15,649,167	14,773,850

Content of zinc ores sold or treated in Colorado in 1921.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Chaffee	81	.....	.....	.....	.....	39,000
Clear Creek	50	1.61	718	.....	3,156	17,000
Lake	5,596	12.30	2,519	.....	64,408	1,821,000
Total, 1921	5,727	13.91	3,237	.....	67,564	1,877,000
Total, 1920	96,232	554.91	88,837	40,004	1,705,979	33,456,257
Decrease, 1921	90,505	541.00	85,600	40,004	1,638,415	31,579,257

Gold and silver produced at mills in Colorado, 1920–1921.

County.	Ore to gold and silver mills.	Gold in bullion.	Silver in bullion.	Ore to concentrating mills.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
Boulder	578	950.08	11	11,806
Clear Creek	2,021	146.50	41	28,983
Costilla	.....	2.52	.....	.....
Gilpin	1,846	625.18	158	1,031
Gunnison	.....	11.85	8	.....
Lake	.....	608.58	198	.....
La Plata	.....	5.23	38	.....
Ouray	31,144	222.00	407	37,575
Pitkin	.....	.....	683	23,697
Saguache	.....	.....	.....	5,690
San Juan	.....	18.09	1	.....
San Miguel	364,964	22,886.32	20,703	89,008
Summit	100	63.72	27	8,480
Teller	484,110	193,192.76	30,296	.....
Total, 1921	884,763	218,732.83	52,571	206,270
Total, 1920	626,900	223,362.80	138,307	677,113
Increase or decrease, 1921	+257,863	−4,629.97	−85,736	−470,843
Average content per ton, 1921	.....	0.2472	0.05942	.....

Mine production of metals from Colorado concentrates in 1921.

By counties.

County.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Boulder	609	395.65	46,008	.....	102,240	.....
Clear Creek	2,767	903.17	88,022	7,158	867,474	217,000
Gilpin	318	263.27	4,667	3,355	22,564	.....
Ouray	6,020	3,299.07	651,028	45,232	991,537	.....
Pitkin	2,808	.....	47,899	.....	469,845	.....
Saguache	217	31.88	30,085	9,770	50,203	.....
San Miguel	32,277	47,944.23	1,658,477	893,000	7,704,824	.....
Summit	968	168.02	35,275	14,037	215,724	.....
Teller	3,156	14,427.08	7,039	.....	.....	.....
Total, 1921	49,140	67,432.37	2,568,500	972,552	10,424,411	217,000
Total, 1920	119,233	72,306.27	2,406,336	2,316,572	29,043,127	28,422,325
Increase or decrease, 1921	−70,093	−4,873.90	+162,164	−1,344,020	−18,618,716	−28,205,325

By kinds of concentrates.

Class.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Dry gold	3,512	14,872.32	8,626	2,879	9,040	.....
Dry gold and silver	2,025	11,213.49	191,927	8,837	13,190	.....
Dry silver	3,245	1,284.88	408,651	.....	116,213	.....
Copper	68	89.83	989	5,400	2,301	.....
Copper-lead	119	14.20	7,280	9,770	42,897	.....
Lead	39,836	39,949.04	1,948,386	944,718	10,225,992	.....
Total to copper and lead plants	48,805	67,423.76	2,565,859	971,604	10,409,633	.....
Zinc	335	8.61	2,641	948	14,778	217,000
Total to zinc and lead-zinc plants	335	[a] 8.61	[a] 2,641	[a] 948	[b] 14,778	[c] 217,000
	49,140	67,432.37	2,568,500	972,552	10,424,411	217,000

[a] Recovered in zinc residues.
[b] Lead recovered in zinc residues and leaded zinc oxide.
[c] Zinc recovered as metal and zinc in zinc oxide.

Average content of concentrates.

	Gold.	Silver.	Copper.	Lead.	Zinc.
	Fine ounces per ton.	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*
Dry gold	4.23	2.45	0.04	0.13	.....
Dry gold and silver	5.53	94.78	.22	.33	.....
Dry silver	.39	125.93	.....	1.79	.....
Copper	1.32	14.54	3.97	1.69	.....
Copper-lead	.12	61.18	4.11	18.02	.....
Lead	1.00	48.91	1.19	12.84	.....
Total average	1.38	52.57	.99	10.66	.....
Zinc	.03	7.88	.14	2.21	[d] 40.48
Total average	.03	7.88	.14	2.21	[d] 40.48

[d] Assay of content; no deduction for loss in smelting.

Mine production of metals from Colorado crude ore shipped to smelters in 1921.

By counties.

County.	Crude ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Boulder	792	301.05	66,938	302	38,096	.....
Chaffee	2,402	1,549.65	27,641	8,357	318,666	39,000
Clear Creek	1,763	829.75	43,804	14,361	333,457	.....
Custer	568	8.90	19,191	37,690	106,022	.....
Dolores	386	89.78	14,499	744	18,624	.....
Eagle	39,785	3,130.98	682,550	1,833,078	12,578	.....
Gilpin	676	1,027.68	13,138	9,831	69,080	.....
Gunnison	498	869.69	10,362	.....	51,955	.....
Hinsdale	495	165.68	32,039	9,357	65,756	.....
Lake	80,501	14,047.11	1,043,219	1,107,295	3,537,889	1,821,000
La Plata	1,279	2,180.40	20,289	.....	3,734	.....
Mineral	7,076	184.60	192,468	1,899	156,778	.....
Ouray	513	21.38	79,535	39,807	216,862	.....
Park	4,929	1,974.72	47,543	7,550	654,090	.....
Pitkin	36,779	.....	425,643	233	1,925,777	283,000
Saguache	722	57.90	60,786	39,742	148,483	.....
San Juan	1,164	382.07	64,178	28,558	557,555	.....
San Miguel	1,309	223.62	97,783	28,573	731,420	.....
Summit	8,711	776.88	64,538	13,513	289,233	.....
Total, 1921	190,348	27,821.84	3,006,144	3,180,890	9,236,055	2,143,000
Total, 1920	267,280	45,942.16	2,857,976	1,727,162	17,586,661	20,368,417
Increase or decrease, 1921	−76,932	−18,120.32	+148,168	+1,453,728	−8,350,606	−18,225,417

By kinds of ore.

Class.	Crude ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Dry gold	4,483	8,116.08	33,967	39,629	61,950	.....
Dry gold and silver	8,170	6,796.55	114,114	217,971	144,463	.....
Dry silver	130,351	5,986.47	1,906,123	1,599,438	3,835,327	.....
Copper	22,195	1,811.24	382,521	1,164,248	10,522	.....
Copper-lead	820	24.60	40,949	78,448	184,221	.....
Lead	18,217	5,074.60	523,736	81,156	4,831,164	.....
Total to lead and copper plants	184,236	27,809.54	3,001,410	3,180,890	9,067,647	.....
Zinc	5,677	12.30	2,519	.....	64,408	1,860,000
Lead-zinc	435	.....	2,215	.....	104,000	283,000
Total to zinc smelters and zinc oxide plants	6,112	[a] 12.30	[a] 4,734	.....	[b] 168,408	[c] 2,143,000
	190,348	27,821.84	3,006,144	3,180,890	9,236,055	2,143,000

[a] Recovered in zinc residues.
[b] Lead recovered in zinc residues and leaded zinc oxide.
[c] Zinc recovered as zinc in zinc oxide.

Average content of crude ores smelted.

Class of ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Fine ounces per ton.	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*
Dry gold	1.81	7.57	0.44	0.69	.....
Dry gold and silver	.83	13.97	1.33	.88	.....
Dry silver	.05	14.62	.61	1.47	.....
Copper	.08	17.23	2.62	.02	.....
Copper-lead	.03	49.94	4.78	11.23	.....
Lead	.28	28.75	.22	13.26	.....
Total average	.15	16.29	.86	2.46	.....
Zinc	.002	.44	.....	.57	[d] 40.66
Lead-zinc	.....	5.09	.....	11.95	[d] 20.48
Total average	.....	.77	.....	1.38	[d] 21.91

[d] Assay of content; no deduction for loss in smelting.

Ore, and slimes and sands treated by amalgamation and cyanidation and gold and silver contained in bullion and precipitates in Colorado in 1921.

Process.	Quantity.	Gold in bullion.	Silver in bullion.	Quicksilver used.	Sodium cyanide used.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Amalgamation	658,025	93,335.25	25,595	3,925	.....
Cyanidation	[a] 484,407	125,397.58	26,976	.....	360,000
	.....	218,732.83	52,571	.....	.....

[a] Includes tons of crude ore treated directly by cyanidation and duplicates that part (in the form of slimes and sands) of ore first treated by amalgamation.

MINING INDUSTRY.

The outstanding feature in the decrease in the output of metals in Colorado in 1921 was the almost complete cessation in the marketing of zinc ores, which was foreshadowed in November and December, 1920, when the Empire Zinc Co.'s magnetic separation mill at Canon City was closed and its new zinc oxide plant was closed after a run of a few weeks; the River Smelting & Refining Co.'s matting and fuming plant at Florence was closed, and Middle Western and Eastern zinc-oxide plants abandoned Colorado as a source of zinc ores. The Ohio zinc-oxide plant at Canon City was idle all the year. The Western zinc-oxide plant at Leadville continued into 1921 at part capacity, but was closed in the middle of the year, reopening in October. Only in December, 1921, did shipments again go to a Kansas plant and to the United States Zinc Co., at Blende, Colo., both zinc-oxide plants—the latter having run on stock or Joplin concentrates until the Pueblo flood on June 3; from then on it was idle until December. The effect of the cutting off of markets was seen in the closing, in December, 1920, of the large Sunnyside gravity concentration and selective flotation mill at Eureka, shipments of zinc ore already having ceased from Gilman, Eagle County, of zinc concentrates from Breckenridge, and of zinc and zinc-lead ores from Leadville.

The low zinc market caused a decrease in the production of lead, for most of the zinc ores of Colorado are either a complex galena-sphalerite or galena-sphalerite-pyrite ore. Such zinc ores are often found near lead ores, and many mines in Leadville that produce various classes of ores depend on the zinc market either for their main or subsidiary profits. The mining of lead-zinc ores in Leadville often opens other ores; the closing of lead-zinc production stops the development and shipment of lead ores. Mines that work bodies of other kinds of ore sufficiently large for separate mining, such as the Yak at Leadville, and the Eagle mine of the Empire Zinc Co., at Gilman, were kept open during 1921. The Graham Park (Leadville) mines of the Iron Silver Co., which were closed in April, 1919, and allowed to fill with water, remained closed throughout 1921.

The one important metal that showed an increase in output was silver, owing to the price fixed by the Pittman Act, about $1 an ounce, although this price was 9 cents below the average in 1920. Copper, which is hardly more than a by-product of Colorado ores, also showed a small increase in output but a decrease in gross value. Copper was really dependent on the silver market. The existence of blocked-out

ore bodies in mines having sufficient capital to withstand fires and snow and other troubles—mines like the Smuggler Union and Tomboy, at Telluride, and the Atlas, at Sneffels—permitted a notable increase in the output of silver and gold in San Miguel and Ouray counties. The Liberty Bell mine, at Telluride, abandoned all operations in August, 1921, after successful operation since 1898. The Ophir district, in San Miguel County, experienced a revival. San Juan mines yielded the smallest output since 1882. Aspen, in Pitkin County, was the scene of much new development and some new discoveries of silver ore, but its production of silver and lead decreased. Creede (Mineral County) again showed a decrease in output of silver. Litigation and the low prices of zinc, lead, and copper caused almost complete idleness at Rico, Dolores County, although much development work was done at Dunton. Boulder County's production of gold and silver was maintained at three-fourths of the record in 1920.

The small decreases in the prices of labor and supplies and the return of some of the miners from the copper camps did not prevent the production of gold from falling. Cripple Creek, strictly a gold district, did not quite maintain in 1921 the production it made in 1920; at Breckenridge three dredges were idle, at least two permanently; the Derry Ranch dredge, below Malta, in Lake County, ran only 20 days; the London mine, at Alma, showed a heavy decrease; the Ibex and other Breece Hill mines, at Leadville, were operated with decreased forces or were idle; Gilpin County's gold mines were mostly unproductive; Clear Creek produced less gold than in 1920; La Plata County showed an increase. After several years' testing of placer ground, construction was begun, just below the town of Fairplay, in Park County, on the hull of a Yuba Construction Co. dredge, and orders had been placed for machinery to be delivered in the spring of 1922. The placer area in this company's holdings is said to be sufficient to keep three dredges in operation for 15 years.

The closing of the Pueblo lead smelter after the Pueblo flood of June 3 diverted all ores mined on the Eastern slope to the Leadville plant. The Durango plant continued to operate one furnace, but for a time it appeared as if it too would be compelled to close, and for a time concentrates were sent from Telluride to Leadville. Part of the flues at the Globe plant were used for the precipitation of arsenic, cadmium, and thallium.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1921.

County.	Producing mines.	Ore sold or treated (short tons).	Gold.[a]		Silver.[a]	
			Fine ounces.	Value.	Fine ounces.	Value.
Boulder	46	13,176	1,646.78	$34,042	112,957	$112,957
Chaffee	5	2,402	1,549.65	32,034	27,641	27,641
Clear Creek	48	32,767	1,879.42	38,851	131,867	131,867
Costilla	1	.....	2.52	52	.....	.....
Custer	5	568	8.90	184	19,191	19,191
Dolores	5	386	89.78	1,856	14,499	14,499
Douglas	2	.....	2.27	47	.....	.....
Eagle	7	39,785	3,130.98	64,723	682,550	682,550
Gilpin	36	3,553	1,916.13	39,610	17,963	17,963
Gunnison	6	498	881.54	18,223	10,370	10,370
Hinsdale	6	495	165.68	3,425	32,039	32,039
Lake	41	80,501	14,954.84	309,144	1,043,497	1,043,497
La Plata	17	1,279	2,185.63	45,181	20,327	20,327
Mineral	8	7,076	184.60	3,816	192,468	192,468
Ouray	11	69,232	3,542.45	73,229	730,970	730,970
Park	10	4,929	1,995.47	41,250	47,547	47,547
Pitkin	17	60,476	.....	.....	474,225	474,225
Saguache	9	6,412	89.78	1,856	90,871	90,871
San Juan	17	1,164	400.16	8,272	64,179	64,179
San Miguel	15	455,281	71,054.17	1,468,820	1,776,963	1,776,963
Summit	23	17,291	17,358.40	358,830	104,198	104,198
Teller	47	484,110	207,619.84	4,291,883	37,335	37,335
Total, 1921	382	1,281,381	330,658.99	6,835,328	5,631,657	5,631,657
Total, 1920	416	1,571,293	366,504.43	7,576,319	5,409,335	5,896,175
Increase or decrease, 1921	−34	−289,912	−35,845.44	−740,991	+222,322	−264,518

County.	Copper.		Lead.		Zinc.		Total value.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
Boulder	302	$39	140,336	$6,315	.....	.....	$153,353
Chaffee	8,357	1,078	318,666	14,340	39,000	$1,950	77,043
Clear Creek	21,519	2,776	1,200,931	54,042	217,000	10,850	238,386
Costilla	.....	.....	.....	.....	.....	.....	52
Custer	37,690	4,862	106,022	4,771	.....	.....	29,008
Dolores	744	96	18,624	838	.....	.....	17,289
Douglas	.....	.....	.....	.....	.....	.....	47
Eagle	1,833,078	236,467	12,578	566	.....	.....	984,306
Gilpin	13,186	1,701	91,644	4,124	.....	.....	63,398
Gunnison	.....	.....	51,955	2,338	.....	.....	30,931
Hinsdale	9,357	1,207	65,756	2,959	.....	.....	39,630
Lake	1,107,295	142,841	3,537,889	159,205	1,821,000	91,050	1,745,737
La Plata	.....	.....	3,734	168	.....	.....	65,676
Mineral	1,899	245	156,778	7,055	.....	.....	203,584
Ouray	85,039	10,970	1,208,399	54,378	.....	.....	869,547
Park	7,550	974	654,090	29,434	.....	.....	119,205
Pitkin	233	30	2,395,622	107,803	283,000	14,150	596,208
Saguache	49,512	6,387	198,686	8,941	.....	.....	108,055
San Juan	28,558	3,684	557,555	25,090	.....	.....	101,225
San Miguel	921,573	118,883	8,436,244	379,631	.....	.....	3,744,297
Summit	27,550	3,554	504,957	22,723	.....	.....	489,305
Teller	.....	.....	.....	.....	.....	.....	4,329,218
Total, 1921	4,153,442	535,794	19,660,466	884,721	2,360,000	118,000	14,005,500
Total, 1920	4,043,734	744,047	46,629,788	3,730,383	48,790,742	3,952,050	21,898,974
Increase or decrease, 1921	+109,708	−208,253	−26,969,322	−2,845,662	−46,430,742	−3,834,050	−7,893,474

[a] Includes placer production.

REVIEW BY COUNTIES.[1]

BOULDER COUNTY.

Central district.—The Central district, near Jamestown, produced 138 tons of ore carrying $4,099 in gold and 545 ounces of silver, having a total value of $4,644, as compared with $4,450 in 1920. All work was confined to lessees, who shipped small lots from 9 properties. The largest shipments were those made from the Wano and the Gladstone to the Golden Cycle mill (Colorado Springs) and from the Black Rose to the Boulder sampler. This district has heretofore produced considerable fluorspar (very little in 1921), and, with favorable markets and railroad rates and improved metallurgic treatment, its deposits are still capable of production.

Gold Hill district.—The Gold Hill district produced 341 tons of ore, which carried $10,725 in gold, 1,748 ounces of silver, and 8,379 pounds of lead, having a total value of $12,850, as compared with $18,472 in 1920. Of the 15 producing properties the principal mines were the Emancipation and the Scotia, from which gold ore was shipped to the Golden Cycle mill; the Grace and the Nil Desperandum, from which gold ore was shipped to the Boulder sampler; and the Miners Hope, from which a car of lead-silver ore was shipped to the Pueblo smelter.

Grand Island district (Cardinal, Caribou, and Eldora).—The Grand Island district produced 1,678 tons of ore, carrying $5,478 in gold, 39,565 ounces of silver, and 22,557 pounds of lead, having a total value of $46,058, as compared with $69,366 in 1920. The principal producing mine continued to be the well-known Caribou mine, from which several sets of lessees continuously throughout the year shipped high-grade silver ore in small lots. The Boulder County mine and gravity concentration and oil flotation mill was operated for three months only. In testing the new concentration mill at the Blue Bird mine, on North Boulder Creek, several hundred tons of silver ore was highly concentrated to make a few tons of lead-silver concentrates of very good grade. From the Potosi mine, at Caribou, a test lot of several hundred tons of silver ore was run through the Clark mill of the Boulder Tungsten Production Co., at Tungsten. Small shipments of ore were made from the Up-to-Date and Wigwam. At Eldora, a few tons of gold ore from the Huron property was tested by amalgamation at the 10-ton plant on the property. A small lot of gold ore was sold to the Boulder sampler from the Shirley group, at Eldora.

Magnolia district.—Several small lots of ore, aggregating 27 tons, were shipped from the Magnolia district.

Sugar Loaf district.—The Sugar Loaf remained the principal producing district in the county, making an output of 8,624 tons of ore, carrying $12,548 in gold, 60,492 ounces of silver, 302 pounds of copper, and 16,468 pounds of lead, with a total value of $73,820, as compared with $89,236 in 1920.

The Colorado United Mines Co., after several years' development of the Forest-Ogallalah claims, at Wallstreet, which included the building and operation in 1920 of a 100-ton gravity concentration and oil-flotation mill, ran a large quantity of low-grade material through

[1] For production by counties see table, p. 489.

the mill in 1921, producing by a high ratio of concentration several hundred tons of commercial-grade silver concentrates until July, 1921; the creditors then operated the mine and mill for a few months before closing. Lessees on the Yellow Pine maintained a steady though small production of good-grade silver smelting ore. Several hundred tons of Yellow Pine ore was tested in a small gravity-concentration and oil-flotation plant built on the property, but results were not satisfactory. The Logan mine continued to produce specimen gold and small lots of smelting ore of very good grade. From the Wood Mountain mine several cars of gold ore were shipped to the Golden Cycle mill (Colorado Springs).

Ward district.—The Ward district produced 2,368 tons of ore, carrying $54 in gold, 10,579 ounces of silver, and 92,932 pounds of lead, with a total value of $14,815, as compared with $43,043 in 1920. The White Raven gravity-concentration and oil-flotation mill was operated 234 days to September, when operations were permanently discontinued.

CHAFFEE COUNTY.

Chalk Creek district (Romley).—Lessees on the upper levels of the Mary Murphy group and the adjoining Iron Chest group (the latter opened from the Mary Murphy workings), shipped from the Chalk Creek district to the Leadville smelter a considerable quantity of siliceous gold and silver ore, carrying also less than 5 per cent of lead, and several cars of gold-silver ore, carrying also more than 5 per cent of lead. The ore was mostly sulphide, but some oxidized ore also was shipped. Work by the lessee on the lower workings (1,400-foot level) ceased March 15, 1921. The 175-ton wet-concentration mill (with flotation plant for treatment of slimes) and the 25-ton electrostatic-separation plant for the treatment of middlings were not in operation in 1921. This mine continued to be the principal producer in Chaffee County. The Rarus-Warrior Mines Co. cleaned and sampled the old Rarus-Warrior workings—beginning in March—and from August 25 to December 31 drove a lower adit 415 feet long and extended the old 100-foot upper adit to 150 feet. New buildings were also erected.

Free Gold district (Buena Vista).—Development work was done at the Marion property during November and December.

La Plata district (Granite).—A 1-ton lot of silver-lead ore was shipped from the Banner property to Leadville.

Middle Cottonwood Creek district (Buena Vista).—At the Gladstone mine, reopened in 1920 after an idleness of 25 years, much development work was done in 1921, consisting of 700 feet of drifts, 150 feet of crosscuts, and a 300-foot raise to connect with old surface workings. Also a hydroelectric plant was completed and placed in operation during December. A 50-ton wet-concentration mill, consisting of crusher, Marcy ball mill, Bunker Hill screen, drag classifier, hydraulic classifier, Wilfley and Card tables, was completed in December, but continuous bad weather delayed setting the plant in operation.

Monarch-Garfield district.—The Madonna mine was the only producing mine in 1921, lessees shipping several cars of lead oxidized and zinc oxidized ores to Leadville and Blende, respectively. During the summer, a force of 10 men was employed at the Columbus mine, retimbering and reopening 921 feet of adit and 800 feet of drifts and

crosscuts. Much development work was done at the Giant-Eclipse mine. Beginning February, 1921, the main adit, 2,600 feet long, on the Lilly group was reopened and retimbered. Development work was continuous at the Jewell group.

Riverside district (Buena Vista).—A car of lead-silver-gold sulphide ore was shipped to the Leadville smelter from the Mount Harvard mine.

Turret district.—Some development work was done in the Turret district.

CLEAR CREEK COUNTY.

Alice (Yankee, Lincoln) district.—The Roosevelt Mining & Milling Co. continued development of various claims in the Alice district, added 5 stamps to its 5 stamp mill, and operated the mill for two and one-half months, the products being gold-silver bullion and several tons of gold concentrates.

Argentine district.—Milling and smelting ores from the Kitty Owsley, Gold Belt, and Waldorf mines yielded $49 in gold, 2,284 ounces of silver, and 3,912 pounds of lead, having a total value of $2,509 as compared with $18,641 from the district in 1920.

Empire district.—Lessees on the Bellevue-Hudson mine, south of the Empire railroad station, shipped lead-silver sulphide ore to the sampler at Idaho Springs. The Nelson Leasing & Development Co. built a small amalgamation-concentration mill during the year, in which was milled several hundred tons of gold ore from the Silver Mountain mine, on Silver Mountain. Development work was continued at the various properties of the Golden Empire Mining Co., in which are included the Tennessee, Denver City, Breckenridge, General Harrison, and other groups. At the Empire Tunnel group, including the Gold Dirt and Tenth Legion claims, and others, cleaning and retimbering of the shaft and drifts was done.

Griffith (Georgetown, Silver Plume) district.—The Georgetown-Silver Plume district produced 18,199 tons of ore, yielding $2,672 in gold, 65,343 ounces of silver, 1,706 pounds of copper, 468,267 pounds of lead, and 217,000 pounds of zinc, with a total value of $100,157, as compared with $275,345 in 1920.

The largest output made in this district came from the remodeled Burleigh mill, in which considerable old dump and surface material from the Dives-Pelican group was concentrated at a high ratio into several hundred tons of silver concentrates of good grade. This mill, equipped with crushers, ball mill, 7 Wilfley tables, and flotation cells was destroyed by fire December 26, 1921. The Wasatch jig and table concentrating mill was operated only three months on lead-zinc ore from the Mendota-Frostburg mine and custom ore from the Backbone mine. Several hundred tons of dump material from the Buster-Snowdrift property was concentrated at the Hudson mill, at Idaho Springs. All other operations resulted in the shipment of only small lots of ore.

Idaho Springs district.—The Idaho Springs district produced 8,200 tons of ore, carrying $29,203 in gold, 33,949 ounces of silver, 16,690 pounds of copper, and 481,156 pounds of lead, with a total value of $86,957, as compared with $166,050 in 1920. Ore shipped through the sampler to smelters or direct to smelters amounted to 1,179 tons; 7,021 tons went to mills in the district.

The largest producing property was that controlled by the Gem Mining Co., which mined both milling and smelting silver-lead-gold ore from the Franklin group and the Gem group. The milling ore was treated at the Newton mill. Lessees on the Edgar and Bellman mines of the Big Five Co. continued to mine both milling and smelting gold ore. Many small lots of ore were marketed from various properties including the Almaden, Argo (in Ute Creek), Champion-Trio, Chicago-Hays, Crocket, Dominion, Fraction, Idaho-Bride, Lake, Lincoln group, Lincoln, Little Emma, Little Mattie, Lord Byron, Metropolitan, and Morning Star.

The Hudson and Newton were the only mills operated during the year.

Montana (Lawson, Dumont) district.—The Montana district from 5 mines produced 5,109 tons of ore, yielding $2,391 in gold, 24,975 ounces of silver, 2,682 pounds of copper, 194,533 pounds of lead, with a total value of $36,466, as compared with $28,597 in 1920.

The Blue Ridge Mines Co. shipped from the Senator mine several hundred tons of silver ore to the Hudson concentrating mill at Idaho Springs, as well as several cars of lead-silver smelting ore. The Whale Mines Leasing & Reduction Co. took over the old Jo Reynolds concentrating mill in June, made general repairs, added flotation cells, and in September began shipping steadily lead-silver concentrates from the Jo Reynolds and American Sisters mines. Small lots of ore were marketed from the Lee, Millington, and Platts.

Trail Creek (Lamartine and Freeland) district.—The Trail Creek district produced 125 tons of ore yielding $894 in gold, 918 ounces of silver, 441 pounds of copper, and 35,552 pounds of lead, with a total value of $3,469, as compared with $15,544 in 1920.

Small lots of smelting and milling ores were taken from the Crazy Girl, Lamartine, New Era, Poorman, and Turner-Freeland mines.

COSTILLA COUNTY.

From a 10-foot shaft on the Schwab mine, at Blanca, a small quantity of specimen gold was uncovered and sold to the mint.

CUSTER COUNTY.

Smelting ores were shipped from the Dixie, First Iowa, King of the Carbonates, Lady Franklin, and Franklin mines, near Westcliffe.

The Colorado Lead Products Co. mined a large quantity of cerussite ore from the Terrible mine, at Ilse, which was milled at a high ratio of concentration in a 100-ton concentration mill, the product being a high-grade lead concentrate, only a few tons of which was marketed in 1921.

DENVER COUNTY.

Dismantling the Globe lead-copper plant continued in 1921, but the laboratory and part of the flues were used for the treatment of flue and bag-house dust for the recovery of arsenic, cadmium, and thallium. The General Chemical Co. in 1921 used Texas sulphur and no Colorado pyrite in its manufacture of sulphuric acid and related products.

DOLORES COUNTY.

Dunton district.—Development work on the Emma mine during October, November, and December, resulted in the shipment of a car of silver ore of good grade. Cleaning of old workings and development work at the Rosebud mine resulted in milling some silver ore, with product of a small lot of good silver concentrates.

Pioneer (Rico) district.—Very little mining was done in the Rico district, owing to low prices for lead and zinc and to litigation. Several cars of silver ore were shipped from the Rico Wellington group and the Syndicate group. In the development of the copper, lead, and lead-zinc ore bodies in this district, large deposits of barren pyrite have been blocked out, but the market for pyrite has been very limited.

DOUGLAS COUNTY.

A few ounces of placer gold were washed from gravels near Franktown.

EAGLE COUNTY.

Battle Mountain (Gilman, Red Cliff) district.—Because of the low price of zinc, the large zinc deposits of the Empire Zinc Co., at Gilman, blocked out during 1919 and 1920, may be said to have been nonproducing in 1921. However, the mine was kept in operation by the shipment of large quantities of pyrite ore, carrying silver and copper, an ore particularly suitable for fluxing purposes at the Arkansas Valley, Pueblo, and Durango lead-copper smelters in Colorado, and at the Garfield and Murray plants in Utah, where the iron ores were in demand, because of a lack of such ores and an excess of siliceous ores from Utah mines. Colorado has always had considerable copper in its gold and silver ores. Gilpin County in its early years produced considerable copper used as a carrier for gold and silver in the matte produced at the Argo smelter. This, the first successful smelter in Colorado, was operated at Black Hawk from 1868 to 1878, when it was moved to Denver and operated to 1910. Breece Hill, Carbonate Hill, and Iron Hill mines at Leadville from time to time have shipped appreciable quantities of copper ores, and the complex ores of the San Juan region generally carry some copper; but the Battle Mountain mines of Eagle County showed indications in 1921 of being among Colorado's first copper mines. With the mining of this pyritic copper-silver ore, large quantities of zinc ore which greatly exceed the pyritic ore in quantity were mined and stored in stopes and stock piles and much had to be transported to storage at Canon City for use when the Empire Zinc Co. again reopens its large modern zinc-oxide plant, completed in 1920.

Other producing mines in the Battle Mountain district in 1921 were the Alligator, Alpine, Ground Hog, Pursey Chester, Red Cap, and Star of the West. Much drifting and diamond drilling was done at the Liberty mine on Turkey Creek, with the hope of finding zinc ore bodies.

Brush Creek district (Eagle).—Some work was done in the Brush Creek district in driving an audit to cut under the surface workings of the Lady Belle-North Dakota group, from which several hundred thousand ounces of silver were taken in 1913–1918.

Burns district.—Development work was done on several prospects in the Burns district.

Gypsum district.—Some development work was done on a steeply dipping bedded pyrite deposit with gypsum gangue, with surface outcrop of hematite and limonite, 3 miles north of Gypsum.

Mount Egley district (Edwards).—Some development work was done in this district.

EL PASO COUNTY.

At Colorado Springs the Golden Cycle 1,200-ton roast cyanide mill was operated steadily, but not at capacity, chiefly on ores from the Cripple Creek district, but also on small lots of ore from Boulder County. The Cresson mine, in the Cripple Creek district, continued to contribute a large quantity of the ore going to the Golden Cycle mill, but the Portland Co. during part of the year sent much of its better grade ores to its own Independence mill, at Victor, as well as all its low-grade mine and dump material.

FREMONT COUNTY.

The Empire Zinc Co.'s magnetic separation plant and new zinc-oxide plant, and the Ohio zinc-oxide plant, all at Canon City, were idle in 1921, as was the River Smelting & Refining Co.'s matting and fuming plant, at Florence.

No production was made from the prospects in the Badger Creek, Cotopaxi, and Parkdale districts.

GILPIN COUNTY.

Southern districts (Black Hawk, Central City, Nevadaville, Russell Gulch).—The amalgamation-concentration mills in the southern districts were not operated for any length of time in 1921. The U. P. R. (Buell) mill, overhauled in 1920, was operated for a month or two, the Polar Star mill was operated intermittently, and the Iron City mill was operated for several months. Some Gilpin County milling ores were hauled to Idaho Springs for treatment.

Within the limits of the town of Central City, the East Boston-Rialto yielded several hundred tons of ore.

In the Enterprise district, below Black Hawk, small lots of ore were shipped from the Black Jack, Button, Champion, Mascot, and Wheeler.

In the Hughesville-Hawkeye district, north of Black Hawk, the Midwest Co. unwatered the Cyclops mine, retimbered the shaft 760 feet and sunk an additional 25 feet, did 1,100 feet of drifting and stoping, completed a new 100-ton gravity-concentration and oil-flotation mill, and in the course of development shipped several hundred tons of silver ore to the Iron City concentration mill.

In the area embracing Gunnell Hill and Eureka and Prosser Gulch, the lateral from the Argo tunnell to the bottom of the concrete shaft was cleaned and retimbered and driven 50 feet westerly. A car of lead-silver ore was shipped from the Rara Avis mine.

Production in the area embracing the town of Black Hawk, and Gregory, Bobtail, and Bates hills was confined to small lots from the

After Supper, Homer, Lucky No. 2, Mohaska, Running Lode, and Senator.

Mines in the area embracing Illinois and Leavenworth gulches and the eastern portion of Quartz Hill were idle.

Small lots of ore were mined from the St. Louis-Justice and Vivian-Notoway in the Lake Gulch district.

In the vicinity of Nevadaville, but mined from the Argo tunnel, several hundred tons of gold ore from the Kansas and Ophir-Burroughs mines were sent for treatment to the Hudson and Newton mills, at Idaho Springs.

In the Quartz Valley district small lots of ore were shipped from the Spur-Daisy and Queen of the West mines.

In the Russell Gulch district, lessees shipped a few cars of ore from the Druid mine; several cars of gold ore were shipped from the Fairfield, the Frontenac, and the Gold Rock direct to smelters, and several hundred tons of gold milling ore was treated at the Polar Star mill.

Northern districts.—In the Perigo district, one car of gold ore was shipped from the Perigo mine. Retimbering was done at the Homestake property. On South Boulder Creek, 2 miles southwest of Rollinsville, a car of gold ore was shipped from the Newport-Providence group, opened by a 200-foot adit and 150 feet of drifts.

In the Silver Creek district, near Apex, the Cornucopia Co. built a new mill, equipped with a ball mill, amalgamating plates, concentrating tables, and flotation cells. The vertical shaft 286 feet deep was connected in 1921 with the 950-foot adit.

At Apex, the Evergreen Mines Co. property is developed by a vertical shaft 822 feet deep, 2,550 feet of crosscuts, and 3,140 feet of drifts, and is equipped with a 100-ton flotation plant, idle in 1921. The Illinois property is opened by a 1,100-foot adit, of which 200 feet were driven in 1921.

GRAND COUNTY.

There was no production of metals in Grand County in 1921, but development work was done in the La Plata district (on Williams Fork), in the Elk Mountain district (near Kremmling), and in the Blue Ridge district (near Parshall).

GUNNISON COUNTY.

Domingo district.—Surface development work was done at the Headlight group, and some tunnel work was done on the Headlight power site on Cebolla Creek.

Elk Mountain district.—From the Augusta, opened by a 3,045-foot adit, development was continued, including the installation of a compressor plant and the erection of a part of a tramway.

Gold Brick district (Ohio City).—The Carter mine was operated continuously with a small force, with shipments of several hundred tons of oxidized siliceous gold ore, carrying a little lead carbonate. Lessees on the Gold Links property cleaned up surface material in the form of a few ounces of gold amalgam and a few tons of gold-bearing material sent to the Leadville smelter. Lessees on the Queen mine drove 20 feet of drifts, retimbered 40 feet of drifts, and drew from filled stopes a car of silver sulphide ore.

Quartz Creek (Pitkin) district.—About 400 feet of crosscuts and drifts were driven on the Roosevelt property in 1921.

Tomichi district.—Development work at the Akron mines in 1921 consisted of 317 feet of raises and 15 feet of drifts, and the clean-up and shipment of two cars of lead-silver concentrates produced in 1920.

HINSDALE COUNTY.

The total quantity of ore shipped from Hinsdale County was small but the average grade of silver and lead was comparatively high for present-day Colorado ores. Some development work was done during the summer of 1921 at the Hidden Treasure mine, and several cars of silver-lead oxidized and sulphide ores were shipped. Lessees on the Fanny Fern did 400 feet of drifting and stoping and shipped several hundred tons of siliceous silver ore. Lead-silver ore was shipped from the Gladiator, Pelican, and Ute & Ulay mines. Two cars of comparatively high-grade gold ore were shipped from the Golconda mine during the course of development work. This mine is opened by a 1,300-foot adit and 900 feet of drifts.

No work was done on the Golden Fleece property, but reopening of the Ocean Wave-Vermont group was begun November 1, and some development work was done on both the Belle of the East and the Belle of the West, and on the Black Crook-Ilma-Hiwassee mines. Water power was installed at the Lellie and construction continued on the gravity-concentration and oil-flotation mill. The Colorado Consolidated Mines & Power Co., controlling the Black Wonder group, at Sherman, continued work on the dam and pipe line.

JACKSON COUNTY.

The Wolverine mine, from which copper ore was shipped in 1917–1918, was idle in 1921.

LAKE COUNTY.

In Lake County both placer gold and deep mine gold showed a heavy decrease. The Derry Ranch dredge was operated only 20 days before closing, and the deep mines of Breece Hill were either idle or operated with decreased forces. The production of silver showed only a small decrease, but lead decreased heavily, while copper increased. The output of zinc was confined almost entirely to zinc carbonate shipments to the local plant. Zinc sulphide shipments began only in December. The total quantity of ore mined fell from 172,988 to 80,501 tons. The decrease in the various classes of ores can be seen in the table of classification of Leadville ores.

This county ranked first in the small State output of zinc, ranked second in the production of silver, copper, and lead, but dropped to fourth place in the production of gold.

LEADVILLE DISTRICT.

GENERAL FEATURES.

Of the 80,501 tons of ore mined in Lake County, 79,769 tons came from the Leadville district. The yield was $301,242 in gold, 1,006,321 ounces of silver, 1,095,372 pounds of copper, 3,524,933 pounds

of lead, and 1,810,000 pounds of zinc, and the total gross calculated value was $1,697,988 out of a county total of $1,745,737; in 1920 the value was $4,106,619 out of a county total of $4,320,510; and in 1919 the value was $4,673,448 out of a county total of $4,808,556.

Classification of Leadville ores in 1921.

Character.	Percentage by weight.	Quantity.	Recovered content.				
			Gold.	Silver.	Copper.	Lead.	Zinc.
Sulphide:		*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Siliceous (carrying pyrite)	9	7,446	5,132.50	101,386	222,106	153,457	.....
Iron pyrites [a]	51	40,337	1,965.80	682,288	829,282	1,495,480	.....
Zinc-iron-lead	2	1,292	[b]11.50	[b] 2,401	.....	[b] 62,188	[c]610,000
Total sulphide	62	49,075	7,109.80	786,075	1,051,388	1,711,125	610,000
Oxide:							
Siliceous gold	3	2,591	4,587.10	15,829	23,182	38,575	.....
Siliceous silver	2	1,426	27.00	18,566	3,373	26,748	.....
Lead (iron excess)	.....	435	.....	2,263	.....	106,464	.....
Lead (silica excess)	5	4,023	2,072.00	67,146	.....	1,052,730	.....
Iron flux	8	6,258	82.10	18,471	11,705	234,874	.....
Iron-manganese-flux	15	11,684	86.00	97,773	5,724	354,417	.....
Zinc	5	4,277	.....	.....	.....	.....	[c]1,200,000
Total oxide	38	30,694	6,854.20	220,048	43,984	1,813,808	1,200,000
Metallics (sulphide and oxide) [d]	.....	.....	608.58	198	.....	.....	.....
Total, sulphide and oxide	100	79,769	14,572.58	1,006,321	1,095,372	3,524,933	1,810,000

Character.	Average recovery.				
	Gold.	Silver.	Copper.	Lead.	Zinc.
Sulphide:	*Ounces per ton.*	*Ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*
Siliceous (carrying pyrite)	0.689	13.62	1.49	1.03	.....
Iron pyrites	.049	16.91	1.03	1.85	.....
Zinc-iron-lead	.009	1.86	.....	2.41	[e] 29.38
Oxide:					
Siliceous gold	1.770	6.11	.45	.74	.....
Siliceous silver	.019	13.02	.12	.94	.....
Lead (iron excess)	.....	5.20	.....	12.24	.....
Lead (silica excess)	.515	16.69	.....	13.08	.....
Iron flux	.013	2.95	.09	1.88	.....
Iron-manganese-flux	.007	8.37	.02	1.52	.....
Zinc	.....	.....	.....	.....	[e] 17.97

[a] Includes both ore to lead plants and ore used for making sulphuric acid from which residues were returned to lead plants.
[b] Recovered in zinc residues. Some lead recovered in leaded-zinc oxide.
[c] Zinc in terms of recovered zinc in zinc oxide.
[d] Includes some Cripple Creek and Park County metallics.
[e] Average assay of original content; no deductions for loss in smelting. All to zinc plants.

During 1921 the A. V. smelter of the American Smelting & Refining Co., with 8 furnaces, operated 2 furnaces steadily and 3 furnaces part of the year on Colorado, Idaho, Utah, and other ores. The Western zinc-oxide plant using entirely Leadville ores was closed part of the year. A new drainage and development adit was started by local financing, this one starting in the Arkansas River basin to run under Canterbury Hill and Prospect Mountain. If continued along this line it will cross the Yak tunnel under South Evans Gulch, in the vicinity of the Dolly B-Resurrection ground.

MINES REVIEW.

The Down Town Mines Co. operated its properties during the first 9 months only; the Garbutt Lease was idle; lessees on the Moyer and Tucson mines of the Iron-Silver Co. found no market from May 1 to October, and all other properties of the Iron-Silver Co. were idle all the year; lessees continued to ship from the Ibex but with a much lessened output; the Fanny Rawlings again became an important producer. Lessees on the A. Y. & Minnie shipped a considerable quantity of lead sulphide ores. The Yak mines were operated steadily with a heavily increased output of iron-sulphide ore carrying silver with some lead and copper, but with no shipments of zinc-lead sulphide ores until December, and with shipments of iron pyrites (for sulphur content) confined to the early months of the year. The mines on Carbonate Hill after a small production from upper levels became idle for the first time in many years.

Other producing mines were the Adelaide, American, Carbonate, Chrysolite, Climax, Denver City, Dunkin, Forest City, Gambetta, Golden Eagle (New Vinnie), Gnome-Izzard, La Plata, Lilian, Little Chief, Little Sliver, Matchless, May Queen, Robert E. Lee, and Viining.

The Iron-Silver Mining Co., the only Leadville company that issues a public printed report, says in part:

> The principal mines of your company continued to be idle due to the inability to secure a market for zinc ores.
>
> Leasing activities on your property declined to a low state and the production from that source was the lowest obtained in many years. At the opening of the year under review lease operations were confined to the Moyer mine, which was able to continue shipments of pyrites until April, when the contract for the sale of this ore expired. It being impossible to negotiate further sales of pyrite this mine was forced to close down on May 1, 1921, and has since been idle. From that date until October no production was made from any part of the company's property. In the latter month a market for zinc carbonate ore appeared as the result of the starting up of the local zinc-oxide plant and work was resumed on a lease formerly granted on the upper levels of the Tucson mine where such ore occurs in small and irregular bodies. At the present time this lease is shipping about 400 tons of zinc carbonate ore per month and is the only productive operation on the entire property.
>
> While working the Moyer mine for pyrites such zinc-lead sulphide ore as was encountered and had to be taken out, was stored in the ore house awaiting a market. The improvement in the oxide business created a market for these ores in December, when the tonnage in storage was disposed of. The old mine, however, does not now contain sufficient amount of this class of ore to warrant starting up to mine it alone.
>
> The lessees, in brief, produced 7,241.76 tons of ore during the past year, yielding a net return of $36,892.09, from which the company received the sum of $3,911.45 as royalty payments and $897.14 from other charges.
>
> The tonnage of the various classes of ore shipped, together with the net value of each is as follows:

Class of ore.	Tons (wet weight).	Value.
Iron sulphide	6,154.64	$28,657.08
Zinc-lead sulphide	511.42	4,139.47
Zinc-carbonate	575.70	4,095.54
	7,241.76	36,892.09

OTHER DISTRICTS.

St. Kevin, Sugar Loaf, and Independence districts.—Silver ore was shipped from the Dinero, Gertrude, Prince of Wales, and Virginia, and silver ore and zinc ore from the Griffin mine.

Arkansas River dredge district.—The Derry Ranch dredge was operated only 20 days.

LA PLATA COUNTY.

There was an increased production from La Plata County mines, chief of which were the Cumberland, Incas, May Day, and Valley View in the La Plata district. A car of silver ore was shipped from the Mary Murphy property, in the Cave Basin district.

MINERAL COUNTY.

The output of silver from Mineral County mines (all near Creede) decreased 29 per cent, following a decrease of 26 per cent in 1920. The principal producing mines were the Commodore, Corsair, Last Chance-New York-Del Monte group, Manitoba, and Monon (Wabash Co.).

MOFFAT COUNTY.

No production was made from Moffat County in 1921. The Bromide property, on Douglas Mountain, 80 miles west of Craig, is developed by a 250-foot shaft with 2,000 feet of workings on three levels at 80, 120, and 240 feet.

MONTROSE COUNTY.

The Michigan-Colorado Mining Co., developing in 1920 the La Sal mines, on La Sal Creek, west of Bed Rock, was declared defunct in 1921.

OURAY COUNTY.

Red Mountain district.—The Red Mountain district from 2 mines produced 2,562 tons of ore, yielding $31,512 in gold, 9,728 ounces of silver, 39,969 pounds of copper, and 45,511 pounds of lead, with a total value of $48,444, as compared with $48,713 in 1920. Several cars of high-grade copper ore assaying well in silver were shipped from the Guadalupe mine. Lessees on the Imogene, opened through No. 1 level of the Barstow mine, worked all the year except one month. The gold ore was milled at the Barstow amalgamation, gravity-concentration, and oil-flotation mill.

Sneffels district.—The Sneffels district from 4 mines produced 66,500 tons of ore, yielding $41,643 in gold, 699,566 ounces of silver, 43,403 pounds of copper, and 1,158,800 pounds of lead, with a total value of $798,954, as compared with $568,439 in 1920.

The Atlas mine was operated continuously in 1921 with a larger force of men than in 1920, with the result than an increased quantity of ore was milled at the 100-ton 20 stamp gravity-concentration and oil-flotation mill, and an increased quantity of lead-silver-gold concentrate was produced. The Humboldt mine was operated steadily as against only three months in 1920, with a very considerable increase in quantity of silver ore mined. This ore continued to be milled at

the Smuggler Union mill, at Telluride, but the ore treated and content recovered are credited to Ouray County. A very considerably increased quantity of ore was mined at the Hidden Treasure mine, but the ore in 1920 was smelting ore and in 1921 it was milling ore and was treated at a new mill completed late in the year. The mill was equipped with crusher, rolls, tables, Huntington mills, and flotation cells. The Mountain Top mine was operated 365 days and the mill 360 days. The quantity of milling ore treated was twice that handled in 1920 and there was a like increase in the lead-silver concentrate produced, but the quantity of picked smelting ore was a little less in 1921 than in 1920. The Camp Bird mine amd mill remained idle. The Revenue mine was also idle although plans were made to operate it in 1922.

Uncompahgre district.—The Uncompahgre district produced from 5 mines 170 tons of ore, yielding $74 in gold, 21,676 ounces of silver, 1,667 pounds of copper, and 4,088 pounds of lead, with a total value of $22,149, as compared with $46,856 in 1920.

The ore shipped from this district in 1921 was small in number of tons but was all high-grade silver ore, from the Army & Navy, Des Ouray, Neodesha, Newsboy, and Wedge. Late in December the Bright Diamond (Wanakah) mine was reopened and some ore was taken out and trammed to the remodeled Wanakah amalgamation, gravity-concentration, and oil-flotation mill, but the first bullion and concentrates produced were not marketed until January, 1922.

PARK COUNTY.

Buckskin district.—The installation of pipe and other equipment for hydraulicking was completed at the Buckskin placer and a small quantity of bullion averaging gold 0.762 fine and silver 0.200 fine was recovered in testing the gravel deposit.

Consolidated Montgomery district.—Several cars of silver ore were shipped from the Dolly Varden group and the Russia mine. At the Dolly Varden a force of five men was employed for four months. At the Russia a considerable force of men was employed 322 days, during which time the main adit was driven 193 feet, making the length 2,200 feet; 6 miles of wagon road were built, 2 miles of electric transmission line were strung, a compressor, motors, and drills were installed, and a bunk house and engine room were built.

Fairplay district.—Construction was begun on the new dredge to operate in Platte River, just below Fairplay. It is expected to be ready for operation by May, 1922. A large acreage of placer ground extending for several miles below Fairplay, has been tested and drilled, and it is rumored that two more dredges will be built, each twice the size of the first, one to be completed in 1923 and one in 1924.

Hall Valley district.—The Whale mine and concentration mill were operated from June through October, the ore being concentrated to a marketable lead-silver product. The La Clede-Missouri group was worked continuously with a small force, and one car of silver-copper ore was shipped.

Horseshoe district.—The Hill Top mine was operated 199 days, as compared with 366 days in 1920. The quantity of ore, an oxidized ore carrying silver and lead with siliceous gangue, shipped in 1921 was less than in 1920, but the ore contained a higher average of silver per ton in 1921.

Mosquito district.—The London mine continued as a producer of high-grade gold smelting ore. Two cars of silver-lead ore were shipped from the Hock Hocking mine. A small lot of high-grade silver ore was shipped from the Champaign mine by lessees operating until August. A new set of lessees began work in November.

Tarryall district.—A small quantity of bullion averaging gold 0.803 fine and silver 0.189 fine was marketed from the Peabody placer.

PITKIN COUNTY.

Aspen (Roaring Fork) district.—The Smuggler Leasing Co. continued to ship large quantities of dry silver ores, carrying some lead, also some lead-silver oxide ores and some lead-zinc ores. This lease covers the properties of the Smuggler, Compromise, Late Acquisition, and Mollie Gibson companies. The Smuggler mill was idle. In the early part of the year the Hunter Creek mill was operated steadily on material from the dump of the Cowenhowen adit. Beginning in February, the Silver Mines of America repaired 2 miles of the $2\frac{3}{4}$ miles of the Cowenhowen Tunnel, a transportation adit tapping the Free Silver, Della S., Bushwhacker, Mineral Farm, Homestead, and Alta Argent properties on Smuggler Mountain, and in the last half of the year drew stope material, which was milled at the Hunter Creek concentration mill, to which an experimental flotation plant was added. Some ore from the Spar property was also treated at this mill. A large quantity of ore carrying silver with lime gangue was shipped from the Aspen Fraction. Dry silver ore was shipped to smelters from the Millinee and spar groups. The Newman group, opened by an adit 4,500 feet long and an incline from the adit 900 feet deep, yielded several thousand tons of lead-silver oxide ore. The Park Tunnel Mining & Milling Co., controlling a large area in Tourtelotte Park, shipped several hundred tons of silver oxide and lead-silver oxide ores, from the Best Friend, Sam Houston group, and from the Bob Ingersoll group. This company's main adit 3,165 feet long, completed in 1921, is at a lower level, and no ores were taken from it in 1921. The Hope Mining, Milling & Leasing Co., a local organization, continued to drive its long crosscut and in August struck a contact of shale and limestone, in which was found ore containing silver minerals and wire silver. Before the end of the year several cars of ore were shipped with a high content of silver and a little lead, in a gangue averaging 67 per cent of silica and 5 per cent of iron. A sublessee on the upper levels of the Hope property removed some old stope filling in November and milled the material at the Richmond Hill Co.'s flotation mill. The Hurricane Leasing Co. drove 900 feet of crosscut in 1921.

ROUTT COUNTY.

A parcel-post test shipment of gold ore was made from the Minnie D, at Hahns Peak. This property is opened by a 325-foot vertical shaft, an adit 600 feet long, and 600 feet of drifts. The Royal Flush group is opened by several vertical shafts totaling 500 feet, an adit 2,200 feet long, and 15,800 feet of underground development; it is equipped with a 40-ton concentration plant. It is proposed to test below the lower adit level by diamond drilling in 1922.

SAGUACHE COUNTY.

Kerber Creek (Bonanza) district.—The production of metals from Bonanza decreased slightly in 1921. The Cocomongo Co., which had greatly increased its production in 1920 over 1919 by sending its milling ore to the Bonanza concentration-flotation mill, continued to operate the mill to March 1, at the same time sending some good-grade lead-copper-silver ore to the smelters. From then on to the close of 1921 only a few men were employed on development, with occasional shipments. From the Eagle mine, reopened and equipped with a flotation mill in 1920, shipments of ore and concentrate carrying a high content of silver were made in 1921. Several cars of silver-lead ore were shipped from the Baltimore, Hanover, Liberty, Mary McGinnis, and Paragon mines. No mining was done on the properties included in the proposed consolidation of the Rawley and adjacent properties, but associated interests purchased the idle Salida lead-copper smelting plant. The general plan includes the building of a large concentration mill at Shirley, on the Salida-Montrose narrow-gage branch of the Denver & Rio Grande Western Railroad, and the building of an 8-mile aerial tram from Shirley to Bonanza.

SAN JUAN COUNTY.

From a production in 1920 of metals with the largest gross value in the history of the county to a production in 1921 with the smallest value since 1882 is an example of the vicissitudes of mining and of the effect of the decreased price of lead and zinc. The production in 1920 was valued at more than 3½ times the production in 1919—a low-record year; but the production in 1921 showed a decrease of 97 per cent as compared with 1920.

Animas district.—The Animas district (including the mines in the vicinity of Silverton and south and east of Animas River from Silverton to Middleton) yielded only 1,143 tons of ore with a gross value of $99,430 as compared with 19,673 tons and a gross value of $457,315 in 1920. The Iowa-Tiger mine and mill, the largest producer in the district in 1920, was idle all through 1921. The Dives mine was operated 262 days. Lessees on the Silver Lake shipped several hundred tons of lead-silver-gold ore, and a few cars of silver-lead-gold ore were shipped from the Highland Mary and from the North Star (on Sultan Mountain). Other shipments were confined to a car or less each from Anti-Periodic, Ariadne, Big Three, Hamlet, Joe & John, Little Nation, Queen City, and Slide mines.

Eureka district.—From the Eureka district (north of Silverton, including Chattanooga, Animas Forks, Eureka, and Red Mountains), only a few tons of ore was marketed in 1921 from the Early Bird, Gold King, and London. The Sunnyside mine and 500-ton gravity-concentration and selective-flotation mill, which produced in 1920 large quantities of high-grade lead concentrate carrying gold, silver, and copper, and a comparatively high-grade zinc concentrate carrying lead, copper, silver, and gold, was idle all the year 1921.

SAN MIGUEL COUNTY.

San Miguel County's record in 1921, as compared with 1920, showed a very material increase in quantity of ore treated and in gross value of recovered metals.

Iron Springs (Ames and Ophir) district.—The Iron Springs district in 1921 produced 14,809 tons of ore, carrying $7,717 in gold, 157,668 ounces of silver, 61,837 pounds of copper, and 1,101,979 pounds of lead, with a total value of $222,951, as compared with $61,410 in 1920. The San Bernardo mine, reopened and equipped with a concentration flotation mill in 1920 by the Valley View Mining & Leasing Co., was the most important producer in 1921, with a product of several thousand tons of lead-silver concentrates. The Matterhorn Mining & Milling Co. added a 6-cell flotation machine, settling tanks, and Wilfley tables to the Butterfly-Terrible 30-stamp concentration mill, which was operated 141 days on ore from the Butterfly-Terrible mine, adjoining the Matterhorn mine. This company received title deed to the Butterfly-Terrible property in 1921. The Suffolk 20-stamp amalgamation, gravity-concentration, and oil-flotation mill was operated intermittently in 1921 by the Summit Metal Mines Corporation, which did 150 feet of drifting and some stoping on its group of mines. Lessees operated the Carbonero mine 361 days and shipped several hundred tons of lead-silver ore to Durango and Leadville. Smelting ore was also shipped from the American Frenchman, Favorite, New Dominion, Shamus O'Brien, and Silver Bell mines.

Upper San Miguel district.—The upper San Miguel district produced 440,472 tons of ore, carrying $1,461,103 in gold, 1,619,295 ounces of silver, 859,736 pounds of copper, and 7,334,265 pounds of lead, having a total value of $3,521,346, as compared with $3,233,838 in 1920.

The Belmont-Wagner Mining Co., operating the Alta and St. Louis mines, drove the Black Hawk Tunnel (the new lower adit) 922 feet from January to June, and from October to December, inclusive. The mine openings were cleaned and retimbered, and ore was mined from July to the end of the year. The 200-ton table concentration and oil-flotation mill was operated on crude ore from the mine and some tailings from previous operations from July 10 to December 31.

The Liberty Bell Gold Mining Co. operated its mine and 80-stamp 500-ton concentration-cyanidation mill in a final clean-up until August, 1921, when operations were discontinued and the company dissolved and went into liquidation. This company's mine has been in almost continuous operation since 1898.

The Smuggler Union 60-stamp (plus one Allis Chalmers ball mill) amalgamation-concentration mill was operated 362 days on ore from the Smuggler Union mine (San Miguel County), and the Humboldt mine (Ouray County), connected mines, both operated from the San Miguel County side by adits and connected by aerial tram with the mill at Pandora, above the town of Telluride. To this mill was added in 1921 a new concrete and steel 850-ton oil-flotation plant, in a separate building, to replace the flotation plant destroyed by fire in June, 1920, with a resultant increase in quantity of ore milled in 1921 as compared with 1920.

The Tomboy new (in 1920) 600-ton table-concentration and oil-flotation mill, to which some amalgamation machinery was added and used in 1921, was operated continuously with an increased quantity of ore milled in the calendar year 1921 compared with the calendar year 1920.

The annual report of the Tomboy Gold Mines Co. (Ltd.), dated London, December 8, 1921, for the year ending June 30, 1921, containing the report of the manager, dated Telluride, September 1, 1921, says:

During the year 197,557 dry tons of ore were put through the mill, which was an increase of 51,491 tons as compared to the previous year. In addition to this 197,557 tons of ore milled, 6,250 tons of waste rock were sorted out of the total tonnage hauled from the mine since February, 1921.

No development work of any kind was performed in the Argentine during the past year, operations being confined to stoping and the removal of upper level floor pillars.

During the year 81,808 dry tons of ore were drawn from the Argentine, or 41.41 per cent of the total tonnage milled.

Estimating as closely as is to-day possible, the Argentine ore reserves consist of a total 285,000 tons, 175,000 tons of which are still unbroken. Of the total 285,000 tons, 75,000 tons of broken ore and 120,000 tons unbroken ore are below the 1,750-foot level, and this lower part of the mine is now being used for the storing of water to assure a constant ample supply for milling purposes during the season of the year when no surface water is available.

The Argentine should be able to supply easily the same proportion of ore to mill for another year, from above 1,750-foot level, as has been drawn during the past year.

Development done in the Montana mine for the year totalled 1,587.6 feet, and consisted of 787.2 feet of drifting, 783.6 feet of raises and 16.8 feet of crosscutting. The bulk of this work was done on the Virginius vein, as only 57 feet of drifting and 79.8 feet of raising was done on the Montana vein.

The Virginius ore shoot, with what little development has been done to date, is the most promising portion of the mine. Because of the great distance of this work from fresh air the present development is rather slow, but connection through to the surface should be completed by the first of the year and then extensive developments can be prosecuted diligently. If this ore body develops as well as we hope for, the complete exhaustion of the Argentine will not be felt.

The estimated ore reserves of the Montana mine consist of 384,000 tons broken and 180,000 tons unbroken. Of this total of 564,000 tons, 480,000 tons are above 1,750-foot level.

The estimated and assured ore reserves in the Virginius total 39,000 tons, of which 9,000 tons are broken.

The total ore reserves in all three mines amount to 888,000 tons, of which 503,000 tons are already broken.

The Montana produced 105,298 dry tons of ore, or 53.3 per cent of the total milled during the past year, and the Virginius produced 10,451 dry tons, or 5.29 per cent of the total.

Development will soon be under way in drifting north on the Montana level of the Montana to explore the vast territory on this level and above and lying between the present face of the old Montana drift and the Sydney vein.

The new plant on the whole seems to be doing just about as good work as can be hoped for. While the extractions are not all up to what you were led to expect from the preliminary work, it must be borne in mind that shortly after the plant commenced to operate a decided change took place in the grade and character of the ore, and this undoubtedly accounts for the difference between expectations and realizations.

Revenue and expenditure, Tomboy mine, June 30, 1920, to June 30, 1921.

197,557 dry tons ore milled, yielding bullion worth			$56,637.72
Concentrates worth			789,729.32
60-mill clean-up—bullion			24,367.69
60-mill clean-up—concentrates			3,481.85
Miscellaneous (copper bullion)			2,139.66
			876,356.24
Less: Loss on boarding house, rents, etc			5,267.58
			871,088.66
	Per ton.		
Mining and development expenses	$1.73	$340,214.37	
Milling expenses	.65	127,209.06	
Concentrating expenses (including transportation to railway)	.82	162,970.88	
Water supply expenses	.19	37,991.14	
Assay office expenses	.04	7,371.25	
60-mill clean-up expenses	.02	4,735.72	
General expenses	.31	61,684.46	
Taxes and insurance	.22	43,219.16	
Total expense	3.98		785,396.04
Profit			85,692.62

SUMMIT COUNTY.

The low price for zinc in 1921 resulted in a complete cessation of shipments of zinc from Summit County, which was credited with 8,335,963 pounds, with a gross value of $675,213 in 1920. The output of silver, copper, and lead showed slight changes. Dredges and other placer operations yielded $337,980 in gold and 4,358 ounces of silver, as compared with $374,882 in gold and 4,811 ounces of silver in 1920.

Breckenridge district.—The value of the total output of the Breckenridge district from both deep and placer mines was $354,727, as compared with $1,141,194 in 1920.

The Wellington mine was kept in repair but no ore, neither lead nor zinc, was mined. Small shipments were made from the Jessie, June Bug, Minnie B, Missouri, Royal Tiger, and Standard mines.

Two dredges, two sluice mines, and two hydraulic mines were in operation during the year. The Blue River Placer Mining Co.'s dredge of 70 buckets of 8 cubic feet capacity each was operated 12 months on the B. & L. and other placer claims. The French Gulch Dredging Co.'s dredge of 80 buckets of 5 cubic feet capacity each was idle in 1921. The annual report of the Tonopah Placers Co. (subsidiary of the Tonopah Mining Co. of Nevada), reports only one of its three dredges in operation in 1921, the dismantling of one dredge, and the idleness of the third, as follows:

During the past year, No. 1 dredge only has been operated; No. 2 dredge has been floated and dismantled; and No. 3 dredge stands the same as when closed down in December, 1920.

No. 1 dredge handled 1,541,454 cubic yards of material during the year, yielding an average value of 12.5 cents per cubic yard, which, with the holdover clean-up for the previous year from dredges Nos. *2* and *3*, gave a total production of $194,689. In accordance with the usual custom, this dredge will be closed down about the 1st of February, so that the necessary repairs can be made for the coming season.

Production and income statement of Tonopah Placers Co. for the year 1921.

Deficit, December 31, 1920:		
Resulting from charges previously made for depletion of property and depreciation of plant and equipment		$32,205.34
Add: Amount expended for repairs to Dredges Nos. *1*, *2*, and *3* in the years 1915, 1916, and 1917, added to surplus Dec. 31, 1918, but now removed		154,598.99
		186,804.33
Net earnings and income for year 1921:		
Gross value of bullion shipped to mint	$194,689.03	
Cost of operations	174,012.44	
Profit from operations	20,676.59	
Other income	1,755.08	
Net income for the year 1921		22,431.67
		164,372.66
Reserve for year, 1921:		
Depletion—10 per cent on cost of property	$119,783.23	
Depreciation — 10 per cent on cost of plant and equipment	10,164.97	
		129,948.20
Deficit, Dec. 31, 1921, written off against capital stock		294,320.86
Cubic yards dredged		1,541,454
Gold produced	ounces	9,299.73
Silver produced	do	2,444.90
Value per yard		$0.125

Hydraulicking on the Mekka and Washington placers recovered appreciable quantities of gold considering the short time of operation.

Consolidated Tenmile (Frisco, Kokomo, and Robinson) district.—The Consolidated Tenmile district produced from deep mines and placer mines $16,078 in gold, 55,686 ounces of silver, 12,798 pounds of copper, and 211,311 pounds of lead, having a total value of $82,924, as compared with $80,680 in 1920.

The principal producing mine was the Michigan, from which much pyritic silver-gold ore was shipped both to lead smelters and to the General Chemical Co.'s sulphuric acid plant. The Silver Queen increased its production of dry siliceous silver smelting ore and the Elk Mountain, Etta, and Four-Most mines shipped small quantities of lead ore.

The Eureka placer, a sluice mine in McNulty Gulch, produced an appreciable quantity of gold in nine months' operation.

Montezuma district.—Two cars of lead-silver ore were shipped from the Jerry mine (Hancock and other claims) and nearly 50 cars of lead-silver concentrate were shipped from the Pennsylvania (Liberty Co.) gravity-concentration and oil-flotation mill.

TELLER COUNTY.

Crude and dump ore, slags, slimes, concentrates, and stolen bullion in 1921 from the Cripple Creek district, aggregated in recovered gold to United States mints and to smelters, 207,619.84 fine ounces, valued at $4,291,883, as compared with $4,323,998 in 1920, and 37,335 ounces of silver, as compared with 33,789 ounces in 1920.

The Golden Cycle mill, at Colorado Springs, a roast-cyanide plant (with preliminary amalgamation) of 1,200 tons daily capacity, was operated steadily at about half capacity.

In the Cripple Creek district, the Portland Gold Mining Co.'s Independence 1,200-ton daily capacity cyanidation and concentration mill was operated steadily on low-grade company and custom ore at a monthly average of about 19,000 tons.

In Poverty Gulch, lessees on the Gold King mine shipped ore to both the Golden Cycle and the Independence mills.

On Tenderfoot Hill several shipments were made from the Queen Bess mine.

On Globe Hill, lessees from the Stratton estate shipped one car of ore from the Nightingale mine.

On Hoosier Pass, the Hoosier Pass Gold Mining Co. shipped to both the Golden Cycle and the Independence mills.

On the north slope of Ironclad Hill the producing mines were the Damon, Forest Queen, Jerry Johnson, and W. P. H. The Lincoln Mines & Reduction Co. continued to operate the Rex cyanide mill.

On Gold Hill the El Paso Extension Gold Mines Corporation shipped ore from the Index mine from January to July.

On Raven and Guyot hills the producing mines were the Cresson, Doctor-Jack Pot, Elkton, Jo Dandy, Katinka, and Mary McKinney. Shipments were continued from the Economic dump. The Cresson continued to be one of the principal producing mines in the district.

On Beacon Hill desultory shipments were made from the El Paso mine.

On Bull Hill producing mines were the Blue Bird (Buckeye), Dante, Gold Sovereign, Last Dollar, Modoc, Stratton Estate mines (American Eagles, Longfellow, Orpha May, and others), and Wild Horse.

Between Altman and Goldfield producing mines were the Acacia (Burns), Deadwood, Findley, Golden Cycle, Isabella, Little Joe, and Vindicator. The Vindicator Consolidated Gold Mining Co. in its annual report for the year ended December 31, 1921, dated February 1, 1922, says:

> The total development for the year amounted to 7,317 feet, of which 1,448 feet were driven by lessees. The details of the development are as follows.
>
> It having been determined, at least so far as our development extends at present, that the Lillie vein ore shoot as originally opened on the 1,900-foot level of the mine does not extend above the 1,800-foot level and that the vein was quite definitely making commercial ore on top of a comparatively flat phonolite dike, it was decided to extend the 1,800-foot level of the Cycle mine, which would correspond to the 2,000-foot level of the Vindicator shaft, in order to open this ore shoot on its downward extension. This work resulted in the opening of two ore shoots, one of which on the level showed a length of 300 feet and an average grab value in drifting of $22.80 per ton; the second shoot, 240 feet in length, indicating from the average grab assays screening values of $149.50 per ton. On commencing stoping operations on these indicated ore shoots, the values apparently extended but a comparatively short distance above the back of the drift.
>
> Considerable work was done to the west of the principal vein system of the company, on the assumption, indicated from geological data, that there was a vein system in that area which had not been exploited by the company. This work resulted in the opening of two vein systems, both of which were to some extent drifted on. Although spots of a very good grade of ore were opened, no bodies of commercial size were proven.
>
> During the year, 31,950 tons of crude ore were hoisted on company account, from which were produced 4,273 tons of shipping product with a gross value of $127,640, the marketing charges on which were $28,475, and the net returns $99,165.
>
> There were hoisted on lessees' account 52,290 tons, and shipments from this source totaled 33,184 tons, with a gross value of $444,900, marketing charges on which were

$153,646, leaving a net value of $291,254. The company's royalties on lessees amount to $90,775.

In the annual report for 1920 it was stated that our operating staff had for the last few months been taking an inventory of the possibilities, with the object in view of outlining a development campaign for the coming year. The work was carried out on the campaign as outlined, resulting in opening up in various parts of the mine five distinct shoots of ore. The indicated total length of the shoots from the drifts driven on them was 920 feet. However, with one exception, for a length of about 120 feet, these indicated ore shoots did not extend either upward or downward, with the result that early in the fall of 1921 we found ourselves in the following situation: The ore above the 2,000-foot level of the Vindicator was practically exhausted, but with very good values showing for a distance of about 540 feet on the bottom of this level, exploitation of which meant deepening the Vindicator shaft 250 feet. The pumping equipment at the Cycle shaft was about worn out with a further pumping problem developing in case the Vindicator shaft was deepened. Facing these problems, it was obvious that operations had to be discontinued, or the Vindicator shaft deepened and the Roosevelt drainage tunnel driven to a connection with the Vindicator workings at as rapid rate as possible. The unanimous decision of your directors was in favor of the latter alternative.

Excellent progress has been made in both undertakings. At the date of issuance of this report the shaft has been completed to the twenty-first level, the station cut, and drifting on the Lillie vein for the ore shoot lying to the north is going forward. The total drive of the drainage tunnel to a connection with our workings was approximately 3,000 feet, of which two-thirds has been accomplished. During the coming quarter we expect to conclude the tunnel drive and to open a substantial portion of the ore shoot in the Lillie vein.

On Battle Mountain the producing mines were the Ajax, Bonanza, Granite, Portland-Independence group, Rose Nicol, and Strong. The annual report of the Portland Gold Mining Co. for 1921, dated February 20, 1922, says:

The operating of your mining property during the past year was confined to the necessary development and improvements badly needed, on account of our inability to do this during the war and subsequent conditions.

Our new hoist, which will permit us to operate the No. 2 shaft to a depth of 3,500 feet, will be placed in commission within 60 days.

We bought three new electric station pumps having a capacity of 1,000 gallons each. These pumps will be installed before opening the new 2,600-foot level, one of which will be held in reserve as an emergency pump.

The 2,450 or bottom level has been largely opened up, and the main working shaft sunk to the depth necessary for opening up the 2,600-foot level, where we anticipate to be making a production of high-grade ore from two of our known ore shoots by the 1st of May.

We completed a great deal of the preliminary work that will permit us to secure and treat the much needed tonnage of low-grade ore to operate our mill to full capacity during the year 1922. Part of the equipment saved from the wrecking of our Colorado Springs and Victor mills has been removed and placed in our Independence mill for the enlarging of our thickening, agitating, precipitating, and fine grinding departments. In the month of December the mill treated 27,600 tons. In January, 1922, we treated 32,800 tons. A further increase may be expected up to 36,000 tons per month, at which time we will be treating about double the average tonnage treated per month during the past year.

The transportation tunnel on the Independence 700-foot level has been completed to the point where we expect that by the 1st of March we can draw the fills from the first large stope, which will furnish all the low-grade ore desired. By the 1st of May we expect to complete the transportation tunnel and install all the ore chutes necessary to make the fills in our old stopes around the No. 2 shaft available for treatment in the mill.

During the last year the company's operations have suffered from the general adverse mining conditions, from underdevelopment, low grade of available ore reserves, and the heavy burden of necessarily high overhead costs incident to deep mining, distributed to a comparatively small tonnage.

The company handled 233,211 tons of ore containing $1,357,045 in precious metals. Total recoverable values, at settlement prices for metals, were $1,151,725. These figures include lessee and custom ore. Custom ore handled was 17,377 tons, containing 5,374 ounces of gold.

Average production for the first nine months of the year was at the rate of about 17,000 tons per month. Operating on this basis, it became evident that profitable operations could not be conducted under present conditions.

In October plans were worked out and work initiated for placing the property on a basis of 36,000 tons per month production. These plans involve increasing the hoisting capacity of the No. 2 Portland shaft by installation of 5-ton skips, sinking and opening up two new levels in depth, enlarging several of the mill departments, and extending the 700-haulage level of the Independence mine into the Captain area and preparing this area for drawing operations.

As set forth in previous annual reports, the Captain area, which is an intensely mineralized block of ground containing a complex of veins largely worked and filled in past years, contains about 14,300,000 tons of material. While it is impossible to forecast accurately the average grade of material which can be mined by drawing operations from this area, every evidence indicates that the material which will be drawn first, that is, stope fills and the more easily caved portion of the solid, amounting to many million tons, can be screened, making a fifty per cent product that will average between $3 and $4.50 per ton. During the year a 44,553 ton test was made of material from this area. The screened product, equaling 45 per cent of the total drawn, averaged $4.33 per ton.

Operations on the Captain area will be at very low cost. The ore will be caved, transported to the Independence shaft by electric haulage, hoisted in large skips in balance, mechanically sorted by screening, and the products delivered to mill and waste dump by electric haulage. Costs are estimated at from $2.20 to $2.60 per net ton including tailings loss.

When fully opened up and equipped the Captain area can be made to produce from 8,000 to 25,000 tons of net ore per month depending on whether one to three shifts per day are worked.

Present indications are that the 2,450-foot level, the lowest in the mine, will produce as much ore and of about the same grade as has any level below the 2,000. Sinking below this level is in progress. It is estimated that the 2,600-foot level will have necessary new pumps and power equipment installed, the vein cut, and ore production begun by May.

It is the intention to open up new levels in depth as rapidly as possible and provide ores below the Roosevelt Drainage Tunnel up to the maximum hoisting capacity of the shaft, if possible, to mine out and abandon this portion of the mine in the least possible time with resultant decrease in pumping expense per ton mined.

The United Gold Mines Co., controlling properties in various parts of the Cripple Creek district, in its annual report for 1921 says:

During the year, your company has done a large amount of work in trying to open up new territory. The greater part of this has been where a strike would probably mean a new ore body for the company.

The work on the Hardwood has been in a section where other very rich ore bodies have been found. This work is still continuing with good promise.

On the Wild Horse, a surface shaft and crosscut failed to open ore, although the work was in a mineralized country. This work will be continued later.

On the Trail, from the fourteenth level of the Cresson, a large amount of drifting and diamond drilling has been done. A raise has been put through from the fourteenth level to connect with the Anderson and Benkleman workings. There will be considerable tonnage of ore to ship from this work. This also gives good ventilation and more work is planned on veins now showing.

The diamond drill is now working from the 1,200-foot level of the Rose Nicol, crosscutting the Big Banta and Old Ironsides.

The only lessees to do much work or ship were Countryman from the Hardwood; and the Granite Gold Mining Co. from the Bonanza. The Granite is working on a small vein of high-grade ore in the Bonanza.

Total production of property.

	Net tons.	Gross value.
Ore mined before consolidation	26,310	$456,806
Produced under United Gold Mines Co.	257,352	4,692,073
	283,662	5,148,879

Production of the United Gold Mines Co. for the year 1921.

Group.	Dry tons.	Gross value.
Bonanza	501	$21,963
Damon	893	24,996
W. P. H.	111	1,709
Wild Horse	50	419
Requa	147	1,319
Deadwood	23	36
	1,725	50,442

SUMMARY OF MINERAL PRODUCTION IN FOREIGN COUNTRIES, 1919 AND 1920.

By L. M. Jones.

INTRODUCTION.

The complex needs of the industrial world of to-day have rendered every country in some degree dependent on other countries for raw materials; none can now claim to be entirely self-sufficient. This fact was one of the outstanding lessons of the World War, a lesson that should be heeded especially by those engaged in the mineral industry. In view of this interdependence, no mineral operator of the United States may now claim to have an intelligent and thorough grasp of his own industry unless he knows something of the sources of supply, the potentialities, the actual conditions, and the present trend of the mineral industry in other countries. In order to aid in the dissemination of this essential knowledge the following summary of the mineral production of foreign countries has been prepared. This first compilation is incomplete, but it is hoped that statistics for subsequent years may be more comprehensive, as the world settles down to normal conditions and as more and more data of mineral development and output are collected and published. In this summary only those countries are covered for which significant statistics of output are available. Information at hand indicates that in the following countries mineral resources are undeveloped, unimportant, or unknown: Aden, Afghanistan, Albania, Arabia, Armenia, Azores Islands, Bahamas, Basutoland, Bermuda Islands, British East Africa, British Honduras, British Solomon Islands, British West Africa, Canary Islands, Cape Verde Islands, Costa Rica, Dominican Republic, French Equatorial Africa, French Guiana, French Oceania, French West Africa, French West Indies, Guatemala, Haiti, Hejaz, Honduras, Jamaica, Leeward Islands, Liberia, Malta, Mesopotamia, Morocco, Nauru and Ocean islands, Nicaragua, Nyasaland, Palestine, Panama, Paraguay, Persia, Portuguese East Africa, Portuguese India, Portuguese West Africa, Salvador, Somaliland, Southwest African Protectorate, Spitzbergen, Straits Settlements, Syria, Tripoli and Cyrenaica, Uruguay.

Cordial acknowledgment is made of the assistance in obtaining foreign mineral data rendered by members of the diplomatic and consular service of the United States and of the courteous cooperation of many of the official statistical bureaus of foreign countries, and grateful thanks are tendered to the members of the section of foreign mineral reserves, United States Geological Survey, who have so cheerfully given their expert clerical assistance in the preparation of the statistical tables herein.

The quantities are given in metric units, the figures as reported having been converted by the use of the factors listed below. As a rule the metric equivalents corresponding most nearly to the original units have been used—for example, pounds have been converted to kilograms.

1 carat	0.2 gram or 0.0002 kilogram.
1 ton (statute)	1.01605 metric ton.
1 ton (short)	0.90718 metric ton.
1 hundredweight (British)	0.05080208 metric ton or 50.80208 kilograms.
1 pound, avoirdupois	0.45359 kilogram.
1 ounce, troy	0.03110348 kilogram or 31.10348 grams.
1 gallon, imperial	0.045436 hectoliter or 4.5436 liters.
1 cubic foot	0.028317016 cubic meter.
1 bushel (lime)	0.0317513 metric ton.
1 pikol (Dutch East Indies)	0.06168824 metric ton.
1 picul (China, Siam, Federated and Non-federated Malay States, Straits Settlements)	0.06047866 metric ton.
1 picul (Japan)	0.06 metric ton.
1 kin (Japan)	0.0006 metric ton or 0.6 kilogram.
1 kwan (Japan)	0.00375 metric ton or 3.75 kilograms.
1 momme (Japan)	3.75 grams.
1 koku (Japan)	1.80391 hectoliters.
1 cubic shaku (Japan)	0.02783 cubic meter.

In view of the fluctuations in foreign exchange during the years under review, no attempt has been made to convert into terms of United States money the values given in the official statistics, here quoted, representing the values in the country of origin of the minerals reported, as it is believed that conversion at any fixed rate would misrepresent the facts. This point is illustrated by the following copy of one of the circulars published quarterly by the Director of the United States Mint, giving the legal values of foreign coins and notes on the rates of exchange for various countries on January 1, 1920.

TREASURY DEPARTMENT,
OFFICE OF THE SECRETARY,
Washington, D. C., January 1, 1920.

In pursuance of the provisions of section 25 of the act of August 27, 1894, I hereby proclaim the following estimate by the Director of the Mint of the values of pure metal contents of foreign coins to be the values of such coins in terms of the money of account of the United States, to be followed in estimating the value of all foreign merchandise exported to the United States during the quarter beginning January 1, 1920, expressed in any such metallic currencies.

Entries of merchandise liquidated upon the values proclaimed herein will be subject to reliquidation upon the order of the Secretary of the Treasury whenever satisfactory evidence shall be produced to him showing that the values in United States currency of the foreign money specified in the invoices were at the date of certification at least 10 per cent more or less than the values herein proclaimed.

CARTER GLASS, *Secretary.*

Values of foreign coins.

Country.	Legal standard.	Monetary unit.	Value in terms of United States money.	Remarks.[a]
Argentine Republic	Gold	Peso	$0.9648	Currency: Depreciated paper, convertible at 44 per cent of face value; exchange rate about $0.4325.
Austria-Hungary	Gold	Krone	.2026	Exchange rate about $0.0061=1 krone.
Belgium	Gold and silver	Franc	.1930	Member Latin Union; gold is actual standard: Exchange value $0.098.
Bolivia	Gold	Boliviano	.3893	12½ bolivianos equal 1 pound sterling; exchange rate about $0.3257.
Brazil	Gold	Milreis	.5462	Currency: Government paper; exchange rate about $0.28 to the milreis.
British colonies in Australasia and Africa.	Gold	Pound sterling	4.8665	
Canada	Gold	Dollar	1.0000	
Central American States:				
Costa Rica	Gold	Colon	.4653	Exchange rate $0.3448=1 colon.
British Honduras	Gold	Dollar	1.0000	
Nicaragua	Gold	Cordoba	1.0000	Exchange rate $0.995.
Guatemala	Silver	Peso	.9271	Guatemala: Currency, inconvertible paper.
Honduras	Silver	Peso	.9271	Honduras: Currency, bank notes.
Salvador	Gold	Colon	.5000	Exchange rate about $0.5128.
Chile	Gold	Peso	.3650	Currency: Inconvertible paper; exchange rate about $0.1825.
China	Silver	Tael—Amoy	1.5191	The tael is a unit of weight; not a coin. The customs unit is the haikwan tael. The values of other taels are based on their relation to the value of the haikwan tael.
		Tael—Canton	1.5146	
		Tael—Chefoo	1.4529	
		Tael—Chin Kiang	1.4840	
		Tael—Fuchau	1.4052	
		Tael—Haikwan (customs)	1.5457	
		Tael—Hankow	1.4213	
		Tael—Kiaochow	1.4721	
		Tael—Nankin	1.5033	
		Tael—Niuchwang	1.4246	
		Tael—Ningpo	1.4606	
		Tael—Peking	1.4810	
		Tael—Shanghai	1.3876	
		Tael—Swatow	1.4033	
		Tael—Takau	1.5287	
		Tael—Tientsin	1.4721	
		Dollar—Yuan	.9955	The Yuan silver dollar of 100 cents is the monetary unit of the Chinese Republic; it is equivalent to 0.644+ of the haikwan tael.
		Dollar—Hongkong	.9991	
		Dollar—British	.9991	
		Dollar—Mexican	1.0065	
Colombia	Gold	Dollar	.9733	Currency: Government paper and gold; exchange rate about $1.0152 to 1 gold peso.

[a] The exchange rates shown under this heading are recent New York quotations and are given merely as an indication of the values of currencies which are fluctuating in their relation to legal standards.

Values of foreign coins—Continued.

Country.	Legal standard.	Monetary unit.	Value in terms of United States money.	Remarks.
Cuba	Gold	Peso	$1.0000	
Denmark	Gold	Krone	.2680	Exchange rate $0.1925=1 krone.
Ecuador	Gold	Sucre	.4867	Exchange rate $0.4695.
Egypt	Gold	Pound (100 piasters)	4.9431	The actual standard is the British pound sterling, which is legal tender for 97½ piasters.
Finland	Gold	Markka	.1930	Exchange rate $0.03=1 markka.
France	Gold and silver	Franc	.1930	Member Latin Union; gold is actual standard; exchange value $0.0952.
Germany	Gold	Mark	.2382	Exchange rate about $0.0215=1 mark.
Great Britain	Gold	Pound sterling	4.8665	Exchange value $3 83.
Greece	Gold and silver	Drachma	.1930	Member Latin Union; gold is actual standard; exchange value $0.155.
Haiti	Gold	Gourde	.2500	Currency: Inconvertible paper; exchange rate approximately $0.20.
India (British)	Gold	Rupee	.3244	15 rupees equal 1 pound sterling: exchange rate $0.4525.
Indo-China	Silver	Piaster	1.0008	
Italy	Gold and silver	Lira	.1930	Member Latin Union; gold is actual standard; exchange value $0.0769.
Japan	Gold	Yen	.4985	Exchange value $0.5025.
Liberia	Gold	Dollar	1.0000	Currency: Depreciated silver token coins; customs duties are collected in gold.
Mexico	Gold	Peso	.4985	Exchange value silver peso $1.015; gold peso $0.50.
Netherlands	Gold	Guilder (florin)	.4020	Exchange value $0.3775.
Newfoundland	Gold	Dollar	1.0000	
Norway	Gold	Krone	.2680	Exchange rate $0.2075=1 krone.
Panama	Gold	Balboa	1.0000	
Paraguay	Gold	Peso (Argentine)	.9648	Currency: Depreciated Paraguayan paper currency.
Persia	Gold	Achrefi	.0959	Currency: Silver circulating above its metallic value; exchange value of silver kran approximately $0.179.
	Silver	Kran	.1706	
Peru	Gold	Libra	4.8665	Exchange rate about $4.30.
Philippine Islands	Gold	Peso	.5000	Exchange rate about $0.4925.
Portugal	Gold	Escudo	1.0805	Currency: Inconvertible paper; exchange rate about $0.364.
Rumania	Gold	Leu	.1930	Exchange rate about $0.031=1 leu.
Russia	Gold	Ruble	.5146	
Santo Domingo	Gold	Dollar	1.0000	
Serbia	Gold	Dinar	.1930	Exchange rate about $0.046=1 dinar.
Siam	Gold	Tical	.3709	Exchange rate $0.395=1 tical.
Spain	Gold and silver	Peseta	.1930	Valuation is for gold peseta; currency is notes of the bank of Spain, exchange value approximately $0.195.
Straits Settlements	Gold	Dollar	.5678	Exchange rate $0.5025.
Sweden	Gold	Krona	.2680	Exchange rate $0.2175=1 krona.
Switzerland	Gold	Franc	.1930	Member Latin Union; gold is actual standard; exchange value $0.1812.
Turkey	Gold	Piaster	.0440	100 piasters equal to the Turkish £; exchange rate about $1.50=1 Turkish £.
Uruguay	Gold	Peso	1.0342	Exchange rate $1.0504.
Venezuela	Gold	Bolivar	.1930	Exchange rate about $0.1932.

ABYSSINIA.[1]

Extensive deposits of coal, copper, gold, phosphate rock, potash, rock salt, and sulphur are known to exist in Abyssinia, and deposits of feldspar, iron, lead, limestone, marble, mica, petroleum, platinum, silver, tin, and tungsten are also reported; but with the exception of potash, none of these minerals have been commercially exploited.

An enormous deposit of potash occurs in the Asal salt plain, very near the border of Eritrea, which was worked by an Italian company during the World War. The reserves are estimated at 1,000,000 tons.[2] The year of greatest production was 1917, when 3,578 tons was exported. At present the industry, owing to the decline in prices and other causes, is temporarily in abeyance.

Drilling for oil is in progress in the Gildessa district, but so far as known the results have not been encouraging.

Small native undertakings exist for the mining of placer gold, tin, and salt, but data of production are not available.

ALGERIA.

Mineral production of Algeria, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (francs).	Quantity.	Value (francs).
Abrasives: Diatomaceous earth tons	1,000	(b)	1,500	75,000
Antimony ore do			1,894	30,240
Briquets, fuel do	19,216	(b)	(b)	(b)
Cement do	14,556	(b)	36,108	196,540
Clay do	43,163	(b)	96,880	816,400
Coal: Bituminous do	6,239	1,565,989	5,997	1,748,305
Lignite do	1,180	100,300	1,796	197,560
Copper ore c do	530	147,250	687	206,100
Gypsum: For agriculture do			282	12,700
Plaster do	13,200	(b)	24,462	191,870
Iron ore do	738,376	25,565,943	1,096,840	54,598,427
Kaolin do	10	(b)	360	9,650
Lead ore do	8,375	2,740,911	12,211	10,207,244
Lime do	44,947	(b)	97,600	540,300
Petroleum do	833	(b)	680	165,000
Phosphate rock do	271,162	(b)	d 502,614	41,646,385
Pyrites, iron do	11,507	391,238	3,294	141,642
Quicksilver: Ore do	1,200	78,000	(b)	(b)
Metal kilograms	4,761	(b)	(b)	(b)
Salt tons	27,482	2,099,610	28,169	1,543,577
Sand and gravel do	19,000	(b)	18,700	91,600
Stone: Building stone, dressed do	6,750	(b)	13,730	711,300
Other do	491,588	(b)	732,484	3,004,040
Sulphur, native do	424	116,872	21	5,250
Zinc ore do	13,293	2,334,000	26,562	6,571,284

[a] Statistique de l'industrie minérale et des appareils à vapeur en France et en Algérie; also data furnished by the Ministère des Travaux Publics, Paris, France, and the Direction des Mines, Algeria.
[b] Data not available.
[c] Average metal content about 10 per cent.
[d] Includes a small quantity of phosphatized guano.

[1] Information supplied by the American consul, Aden, Arabia.
[2] Nourse, M. R., Potash in 1920: U. S. Geol. Survey, Mineral Resources, 1920, pt. 2, p. 117, 1921.

ARGENTINA.

Mineral production of Argentina, 1918 and 1919, in kilograms.[a]

Mineral.	1918	1919	Mineral.	1918	1919
Alum	66,960	31,300	Quartz	(b)	332,060
Antimony ore	(b)	(b)	Salt	210,170,780	140,248,135
Asbestos	50	(b)	Sand	2,141,850	5,278,300
Borates	2,135,740	2,226,630	Silver, fine d	778	777
Coal c	4,783,890	(b)	Stone:		
Copper ore	551,410	191,460	Limestone	89,352,130	89,944,840
Gold, fine d	6	6	Marble	13,600	163,410
Gypsum	21,530	11,853,910	Other	306,697,100	440,802,260
Lead ore	7,480,250	5,891,680	Sulphur	57,190	40,760
Lime	60,644,910	79,353,040	Tin ore	e 24,220	(b)
Manganese ore	55	(b)	Tungsten ores: Wolfram	563,257	114,710
Mica	172,045	51,940	Zinc ore	(b)	10,000
Petroleum	182,558,191	195,223,159			

a Data furnished by the Dirección General de Minas, Geología é Hidrología, Argentina. Values not stated
b Data not available.
c Includes some peat.
d Data as published by the United States Bureau of the Mint.
e Shipments from the provinces of La Rioja and Catamarca. In addition, 332,050 kilograms was shipped through La Quiaca, Province of Jujuy. This is not included, as it is believed to be Bolivian ore.

Petroleum produced in Argentina, 1919 and 1920, by Provinces, in kilograms.[a]

Province.	District.	1919	1920
Chubut	Comodoro Rivadavia:		
	Government production	173,797,747	209,327,201
	Private production	21,425,412	32,652,936
Neuquen	Plaza Huincul: Government production		522,164
		195,223,159	242,502,301

a Data furnished by the Dirección General de Minas, Geología é Hidrología, Argentina. Subject to revision.

AUSTRALIA.

Mineral production of Australia, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Abrasives: Corundum [b] tons	1	1		
Diatomaceous earth do	248	806	1,406	5,923
Alunite do	2,586	15,156	664	2,686
Antimony, ore and concentrates do	1,399	26,580	1,182	16,788
Arsenic, white do	[c] 1,104	(d)	(d)	(d)
Asbestos do	251	4,666	838	14,780
Barytes do	2,827	8,441	3,873	12,292
Bismuth, ore, concentrates, and metal kilograms	23,166	21,458	78,438	34,435
Cement, Portland [e] tons	138,021	379,896	146,196	719,435
Chromite do	254	616	1,644	5,248
Clay, fire, pipe, and pottery do	14,456	(d)	31,613	(d)
Coal: Bituminous do	10,622,901	6,726,587	13,011,133	9,443,996
Lignite do	113,420	34,542	165,293	64,180
Coke [e] do	431,591	550,127	576,678	844,191
Copper [f] do	19,491	(d)	27,022	(d)
Feldspar [g] do			4	8
Fluorspar do	2,365	8,474	1,839	7,011
Fuller's earth do			14	49
Gems: Corundum grams	2,364	(d)		
Diamonds do	355	1,706	705	6,282
Opals		48,152		48,100
Sapphires grams	230	(d)	617	2,041
Other, not specified		42,883		65,831
Gold, fine grams	33,222,281	4,537,094	29,339,914	4,010,347
Graphite tons	100	100	54	170
Gypsum do	26,454	19,207	44,284	33,300
Iron: Ores [h] do	447,047	(d)	605,513	(d)
Pig iron [i] do	257,828	(d)	349,521	(d)
Kaolin do	5,246	8,032	5,701	6,752
Lead [f] do	71,531	(d)	14,590	(d)
Lime [e] do	31,978	57,411	34,043	80,412
Magnesite do	9,768	8,771	6,919	10,691
Manganese ore do	5,049	15,546	3,007	6,694
Mica kilograms	1,574	984	(d)	412
Mineral paint ores: Ocher, umber, etc. tons	723	2,209	1,877	2,700
Molybdenite do	273	85,243	119	25,391
Oil shale do	26,471	38,868	21,483	46,254
Osmiridium grams	51,943	39,614	62,487	77,114
Pebbles, flint tons	1,263	4,708	430	1,604
Phosphate rock do	9,151	13,479	13,339	17,263
Platinum grams	6,625	3,150	24,758	16,672
Pyrites tons	7,714	9,207	10,628	14,622
Quartz do			992	276
Salt [g] do	70,284	138,348	72,008	141,742
Silica do	10,332	30,507	15,123	29,768
Silver, fine [j] grams	208,293,418	(d)	21,192,979	(d)
Silver-lead ores and concentrates tons	79,474	1,034,094	12,614	164,027
Slate		1,500		5,000
Soapstone tons	404	(d)	129	148
Stone: Limestone for flux do	218,315	66,615	219,183	83,379
Marble do	(d)	3,951	1,072	5,126
Other do	23,317	8,593	15,682	10,062
Talc do	228	785	287	1,097
Tantalite [b] kilograms	254	75		
Tin [f] tons	4,401	(d)	4,273	(d)
Tungsten ores: Scheelite do	302	61,427	133	22,567
Wolfram do	875	148,679	442	63,718
Zinc [f] do	66,101	(d)	10,238	(d)

[a] Compiled from the annual reports of the Departments of Mines of the several Australian States, except where otherwise noted. The lack of uniformity in the statistical methods of the Australian States renders the task of intelligently combining the figures somewhat difficult and at times practically impossible.

[b] Exports.

[c] Figures published by the Imperial Mineral Resources Bureau, London.

[d] Data not available.

[e] Returns from New South Wales only.

[f] Figures of Australian Metal Exchange, Melbourne, representing estimated metal content of ores mined in the Commonwealth.

[g] Returns from South Australia only.

[h] Includes iron oxide used for paint.

[i] Figures of Australian Metal Exchange, Melbourne.

[j] Figures of Australian Metal Exchange, Melbourne, representing refined silver recovered in the Commonwealth. The silver content of the bullion, ores, and concentrates exported, as estimated by the exchange, was as follows: 1919, 437,846 fine ounces (13,619 kilograms); 1920, 663,778 fine ounces (20,646 kilograms).

Mineral production of New South Wales, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Abrasives: Diatomaceous earth....tons..	89	246	390	923
Alunite....do....	2,525	14,910	644	2,536
Antimony: Ore....do....	169	2,342	203	2,505
Metal[b]....do....	88	(c)	(c)	(c)
Arsenic: Ore....do....	6	24	(c)	(c)
White arsenic....do....	(c)	(c)	71	2,840
Asbestos....do....	145	1,938	675	7,404
Barytes....do....	641	2,017	225	767
Bismuth ores and metal....do....	19	20,215	77	33,886
Cement, Portland....do....	138,021	379,896	146,196	719,435
Chrome ores....do....	254	616	1,483	5,090
Clay, fire, pipe, and pottery clays....do....	2,494	(c)	23,910	(c)
Coal....do....	8,770,090	5,422,846	10,887,991	7,723,355
Coke....do....	431,591	550,127	576,678	844,191
Copper, (ingots, matte, and regulus)....do....	1,483	139,296	1,311	127,978
Fluorspar....do....	2,046	7,454	1,213	3,159
Fuller's earth....do....			14	49
Gems: Corundum....grams..	2,364	(c)		
Diamonds....do....	355	1,706	705	6,282
Opals....		27,552		23,600
Sapphires....grams..	230	(c)	617	2,041
Gold, fine....do....	2,047,822	279,666	1,521,178	207,746
Graphite....tons..	102	100	41	40
Iron: Ore[d]....do....	149,135	(c)	165,820	(c)
Pig iron[e]....do....	82,240	445,175	87,478	645,720
Kaolin....do....	2,365	3,314	2,833	3,201
Lead, pig....do....	11,682	324,215	420	9,905
Lime....do....	31,978	57,411	34,043	80,412
Magnesite....do....	9,413	8,032	6,578	9,891
Manganese ore....do....	4,726	13,953	2,470	2,008
Mineral paint ores: Ocher and umber....do....	387	837	965	1,230
Molybdenite....do....	67	30,308	41	8,442
Oil shale....do....	25,861	37,968	21,341	46,082
Phosphate rock....do....	585	2,016	156	732
Platinum....grams..	6,625	3,150	24,758	16,672
Silica....tons..	10,332	30,507	15,123	29,768
Silver, fine[f]....grams..	38,341,572	292,838	4,943,401	36,942
Silver-lead ores and concentrates....tons..	79,241	1,030,825	9,033	76,634
Slate....		1,500		5,000
Soapstone....tons..	364	(c)	27	48
Stone: Dolomite....do....	22,730	7,089	15,046	7,404
Granite....do....	587	1,504	636	2,658
Limestone for flux....do....	84,365	22,779	81,431	30,920
Marble....do....	(c)	3,151	642	2,315
Talc....do....	(c)	(c)	187	383
Tin: Concentrates....do....	1,571	151,363	(c)	413,794
Ingots....do....	1,164	265,260	(c)	
Tungsten ores: Scheelite....do....	81	15,193	21	3,805
Wolfram....do....	137	22,818	14	2,212
Zinc concentrates....do....	73,454	247,395	72,183	249,456

[a] New South Wales Dept. Mines Ann. Rept.
[b] Estimated metal content of ore.
[c] Data not available.
[d] Includes iron oxide, used for paint, and ironstone.
[e] Made from domestic ore at Eskbank Iron Works at Lithgow.
[f] Extracted from domestic ores in New South Wales. The estimated total silver content of the silver-lead ores mined in New South Wales, treated within the Commonwealth of Australia or exported, is as follows: 1919, 196,102 kilos; 1920, 21,005 kilos.

Mineral production of Northern Territory, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Bismuth ores.....kilograms..	(b)	(b)	127	10
Copper ore [c].....tons..	107	1,585	.....	.....
Gold, fine.....grams..	26,407	3,606	18,227	2,489
Mica.....kilograms..	558	470	36	292
Silver-lead ore.....tons..	15	153	16	230
Tin concentrates.....do....	178	24,166	99	15,600
Tungsten ores: Wolfram.....do....	239	39,540	216	28,742

[a] Data furnished by the Director of Mines, Department of Mines, Northern Territory.
[b] Data not available.
[c] Average copper content, 1919, 32 per cent.

Mineral production of Queensland, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Antimony ore.....tons..	3	78	.....	.....
Arsenic, white.....do....	59	2,900	310	16,760
Bismuth.....kilograms..	2,032	655	965	530
Chromite.....tons..	.....	.....	161	158
Clay, fire.....do....	8,502	2,051	7,660	2,188
Coal.....do....	946,584	614,307	1,127,727	841,551
Copper [b].....do....	10,157	952,501	16,152	1,551,995
Fluorspar.....do....	.....	.....	613	1,809
Gems: Opals.....	.....	600	.....	500
Other.....	.....	42,883	.....	65,831
Gold, fine.....grams..	3,764,454	514,103	3,584,054	489,701
Ironstone for flux.....tons..	25,072	27,684	20,025	24,852
Lead [c].....do....	136	4,739	1,736	65,098
Manganese ore.....do....	20	103	15	60
Molybdenite.....do....	120	52,234	29	13,333
Quartz.....do....	.....	.....	992	276
Silver.....grams..	2,863,013	23,772	8,529,663	70,461
Stone: Limestone for flux.....tons..	87,823	27,842	106,754	42,921
Marble.....do....	132	800	430	2,811
Tin concentrates.....do....	1,010	143,167	1,509	252,054
Tungsten ores: Scheelite.....do....	13	2,331	2	462
Wolfram [d].....do....	374	59,277	132	18,783
Whiting.....do....	.....	.....	10	80

[a] Queensland Dept. Mines, Undersecretary for Mines, Ann. Rept.
[b] Estimated copper content of ores produced.
[c] Estimated lead content of ores produced.
[d] Includes bismuth-wolfram ores

Mineral production of South Australia, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Alunite.....tons..	61	246	20	150
Asbestos.....do....	.....	.....	5	90
Barytes.....do....	1,781	5,264	2,583	7,362
Clay, fire and pipe clay.....do....	3,460	1,080	43	8
Copper[b].....do....	2,557	228,930	4,409	423,601
Feldspar.....do....	.....	.....	4	8
Gems: Opal.....	.....	20,000	.....	24,000
Gold, fine.....grams..	100,278	13,696	52,783	7 209
Gypsum.....tons..	25,621	18,725	40,837	31,604
Ironstone.....do....	272,840	307,402	419,667	478,436
Kaolin.....do....	789	1,463	704	1,287
Magnesite.....do....	277	508	188	347
Manganese ore.....do....	303	1,490	522	4,626
Mineral paint ores: Ocher.....do....	148	939	264	1,131
Molybdenite.....kilograms..	203	70	.....	.....
Pebbles, flint.....tons..	1,263	4,708	430	1,604
Phosphate rock.....do....	6,045	8,982	8,893	12,309
Salt, crude.....do....	70,284	138,348	72,008	141,742
Silver.....grams..	17,449	180	31,259	226
Silver-lead ore.....tons..	.....	.....	83	2,420
Soapstone.....do....	40	80	102	100
Stone: Limestone for flux.....do....	46,127	15,994	30,998	9,538
Sulphuric acid.....do....	2,214	3,105	4,442	6,230
Talc.....do....	228	785	100	714

[a] Mining Review, South Australia Dept. of Mines.
[b] Estimated copper content of ores produced in South Australia.

Mineral production of Tasmania, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Asbestos.....tons..	52	1,275	.....	.....
Barytes.....do....	405	1,160	1,065	4,163
Bismuth ores and concentrates.....kilograms..	1,798	573	102	9
Coal.....tons..	67,316	47,004	76,640	64,005
Copper[b].....do....	5,108	504,961	4,869	528,237
Gold, fine.....grams..	239,061	32,650	194,272	29,796
Lead[c].....tons..	2,395	64,403	3,920	142,268
Oil shale.....do....	610	900	142	172
Osmiridium.....grams..	51,943	39,614	62,487	77,114
Pyrites, iron.....tons..	3,512	4,288	4,511	7,346
Silver[d].....grams..	16,339,996	125,564	19,388,635	166,767
Tin[e].....tons..	1,605	395,794	1,331	369,362
Tungsten ores: Scheelite.....do....	202	43,181	107	17,905
Wolfram.....do....	123	26,613	72	13,626
Zinc[f].....do....	290	13,110	9	334

[a] Tasmania Dept. Mines, Secretary for Mines Rept.
[b] Estimated copper content of blister copper and copper ore produced in Tasmania, distributed as follows: 1919, 5,094 tons contained in 5,152 tons of blister and 13 tons contained in copper ore; 1920, 5,868 tons contained in 4,915 tons of blister and 1 ton of ore.
[c] Estimated lead content of silver-lead ores produced in Tasmania.
[d] Estimated silver content of silver-lead ores and blister copper produced in Tasmania, distributed as follows: 1919, in silver-lead ore 9,229 kilos, in blister copper 7,111 kilos; 1920, in silver-lead ores 14,103 kilos, in blister copper 5,286 kilos.
[e] Estimated tin content of ores produced in Tasmania.
[f] Slab zinc produced from zinc ore mined in Tasmania. In addition the following quantities of slab zinc were made from roasted ores from Broken Hill, New South Wales: 1919, 3,437 tons; 1920, 5,900 tons.

Mineral production of Victoria, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Abrasives: Diatomaceous earth ..... tons	159	560	1,016	5,000
Antimony, ore and concentrates ..... do	1,227	24,160	976	14,238
Arsenic, white [b] ..... do	1,041	(c)	(c)	(c)
Coal: Bituminous ..... do	430,750	372,075	449,339	464,739
Lignite ..... do	113,420	34,542	165,293	64,180
Fluorspar ..... do	319	1,020	13	43
Gold, fine ..... grams	4,212,251	575,260	4,752,363	648,969
Gypsum ..... tons	833	482	3,447	1,696
Kaolin ..... do	2,092	3,255	2,164	2,264
Magnesite ..... do	78	231	153	453
Molybdenite ..... do	79	2,531	49	3,616
Mineral paint ores ..... do	188	433	647	339
Phosphate rock ..... do	2,521	2,481	4,290	4,222
Silver, fine [d] ..... grams	190,384	1,607	193,806	1,714
Tin concentrates ..... tons	115	17,561	85	12,815
Tungsten ore: Wolfram ..... do	2	400	8	355

[a] Gold and mineral statistics for the years 1919 and 1920, Department of Mines, Victoria.
[b] Figures reported by the Imperial Mineral Resources Bureau, London.
[c] Data not available.
[d] Extracted from gold at the Melbourne mint.

Mineral production of Western Australia, 1919 and 1920.[a]

[Exports.]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Abrasives: Corundum ..... tons	1	1	.....	.....
Antimony concentrates ..... do	.....	.....	3	45
Arsenic ore ..... do	.....	.....	1,793	4,260
Asbestos [b] ..... do	54	1,443	159	7,286
Bismuth ores and concentrates ..... kilograms	51	15	.....	.....
Coal [b] ..... tons	408,161	270,355	469,436	350,346
Copper: Ore [b] ..... do	1,297	21,530	1,993	37,945
Metal [c] ..... do	113	(d)	260	(d)
Gold, fine [b] ..... grams	22,832,008	3,118,113	19,217,037	2,624,437
Graphite ..... tons	.....	.....	13	130
Iron concentrates ..... do	.....	.....	1	17
Lead: Ore [b] ..... do	7,505	29,841	28,161	172,483
Metal [c] ..... do	1,073	(d)	5,154	(d)
Mica ..... do	1	514	(d)	120
Molybdenite ..... do	7	100	(d)	5
Pyrites [b] ..... do	4,202	4,919	6,117	7,276
Silver, fine ..... grams	6,946,403	55,342	4,064,976	36,605
Silver-lead ore [b] ..... tons	218	3,116	3,482	84,743
Tantalite ..... kilograms	254	75	.....	.....
Tin concentrates ..... tons	323	47,269	247	49,449
Tungsten ores: Scheelite ..... do	6	722	3	395
Wolfram ..... kilograms	254	31	.....	.....

[a] Report of the Department of Mines and the Statistical Register, Western Australia; and data furnished by the Minister for Mines, Western Australia. Figures represent exports of domestic produce, except where otherwise noted.
[b] Production.
[c] Estimated metal content of ores mined.
[d] Data not available.

AUSTRIA.

Mineral production of Austria, 1919 and 1920.[a]

Mineral.		1919		1920	
		Quantity.	Value (kronen).	Quantity.	Value (kronen).
Antimony ore [b]	quintals	500	5,000		
Bauxite [c]	do			3,620	724,000
Coal: Bituminous	do	904,720	23,832,991	1,328,640	225,473,125
Lignite	do	20,067,730	249,001,464	24,088,650	1,468,134,442
Copper: Ore [d]	do	237,509	5,729,855	264,099	16,153,139
Electrolytic copper	do	6,311	15,750,000	15,500	201,500,000
Rolled and hammered copper	do	165	333,500	951	9,506,000
Graphite	do	82,645	1,955,048	115,431	9,183,889
Iron: Ore	do	2,505,202	29,920,434	4,350,851	264,799,966
Pig iron, for steel	do	617,730	90,502,900	981,490	831,478,683
Cast iron	do	1,070	139,927	16,170	17,867,304
Lead, metallic	do	17,641	5,480,223	39,734	85,129,216
Mineral paints: Ochre	do	3,689	16,228	2,548	95,844
Iron oxide	do	3,702	22,212	2,210	34,360
Oil shale, ichthyolic	do	10,034	203,192	10,951	501,129
Petroleum [e]	do	(e)	(e)	(e)	(e)
Pyrites, iron	do	101,730	1,554,358	227,637	9,273,660
Salt: Brine	do	954,337	(f)	794,313	(f)
Rock	do	4,984	(f)	24,550	(f)
Silver, bullion	kilograms	26	277,000	126	580,000
Zinc-lead ore [g]	quintals	791,129	10,126,284	783,513	66,592,872

[a] Official data furnished by the American Mission, Vienna, through the courtesy of the Austrian Ministry for Commerce, Trade, Industry, and Public Buildings.
[b] Average metal content, 1919, 3 per cent.
[c] Average metal content, 1920, 56 per cent Al.
[d] Average metal content, 1919, 2.25 per cent Cu.; 1920, 2.56 per cent Cu, 0.14 per cent Ag.
[e] No reliable data of production of petroleum available. During 1919, 14 quintals of oil were extracted from oil sands.
[f] Value not stated.
[g] Average metal content, 1919, 5.8 per cent Pb, 0.3 per cent Zn; 1920, 5.17 per cent Pb, 0.61 per cent Zn.

BARBADOS.

The minerals produced in Barbados embrace chalk, diatomaceous earth, limestone, manjak, and sandstone. Petroleum has been proved to exist in the island, but the industry has not yet risen to commercial importance.

The output of chalk and diatomaceous earth is very small, and no data of production are available.

About 12 sandstone quarries are regularly operated, in addition to a number of smaller workings that are intermittently active according to their owners' needs. No data of production are available.

Limestone is quarried in many parts of the island, and small quantities are exported for building purposes to the neighboring islands and Demerara. In 1919, 949 tons was thus exported, and 453 tons in 1920.[1]

Manjak has been mined in the island since 1895. The exports of this product in 1919 were 39 tons; in 1920, 92 tons.[2]

BECHUANALAND PROTECTORATE.

Very little is known of the mineral wealth of the Bechuanaland Protectorate. Deposits of asbestos, coal, copper, gold, and silver are reported to exist, but the only available data of production relate to gold and silver. The production of these precious metals, in grams, for the years ended March 31, 1920 and 1921, was as follows:[3] Gold, 55,084 and 148,768, respectively; silver, 3,546 and 14,899, respectively.

[1] Information supplied by the American consul, Barbados.
[2] Great Britain Colonial Reports—Barbados.
[3] Great Britain Colonial Reports—Bechuanaland Protectorate, 1921.

BELGIAN CONGO.

Mineral production of the Belgian Congo, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (francs).	Quantity.	Value (francs).
Copper: Ore [b] tons	876,000	(c)	(c)	(c)
Ingots [b] do	23,028	(c)	18,548	(c)
Matte [b] do			414	(c)
Diamonds [d] carats	199,021	16,857,079	274,103	35,633,390
Gold, crude [d] kilograms	2,892	15,548,486	5,046	36,560,207
Iron ore for flux [b] tons	85,000	(c)	79,732	(c)
Limestone for flux [b] do	[f] 81,000	(c)	70,114	(c)
Tin ore [d] kilograms	178,895	912,365	593,854	4,542,983

[a] Data furnished by the Ministry of Colonies, Brussels, and annual report of the Union minière du Haut Katanga.
[b] Output reported by Union minière du Haut Katanga.
[c] Data not available.
[d] Exports.
[e] One carat=0.2 grams.
[f] Includes 28,000 tons of dolomite.

BELGIUM.

Mineral production of Belgium, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (francs).	Quantity.	Value (francs).
Abrasives: Whetstones, hones, etc. number	31,890	58,800	67,800	96,200
Barytes tons			15,240	878,000
Briquets, fuel do	2,547,899	190,584,850	2,846,370	372,357,900
Chalk, white cubic meters	193,080	1,558,300	488,290	4,978,400
Clay tons	179,060	1,979,650	421,210	7,980,500
Coal do	18,482,880	1,121,249,400	22,388,770	1,989,014,250
Coke do	756,890	70,088,700	1,835,400	284,070,500
Copper [b] do	1,893	5,611,200	7,150	36,642,900
Iron: Ore do	4,820	64,050	17,260	227,350
Pig iron do	250,570	70,584,700	1,116,400	546,257,600
Kaolin and eurite do			1,030	71,400
Lead: Ore do				
Metal, smelter output do	4,225	3,845,150	16,040	28,821,500
Lime cubic meters	575,790	17,953,700	1,069,660	46,530,500
Ocher tons			200	4,000
Phosphate of lime do	90,970	3,079,500	133,040	5,725,000
Phosphatic chalk cubic meters	45,200	511,500	254,820	3,837,500
Pyrites tons	60	6,600		
Sand: For glass manufacture cubic meters	33,190	178,650	46,680	589,900
Other do	242,045	1,144,250	650,050	4,749,900
Silica: For pottery do	1,575	14,000	10,220	350,200
Other do	6,960	54,150	8,640	92,800
Silver [c] kilograms	6,607	1,752,150	14,760	6,413,300
Slate: Roofing slates number	10,211,000	1,557,000	18,860,000	4,189,600
Other square meters	760	6,200	710	19,600
Stone: Building stone, dressed cubic meters	46,742	8,684,100	114,730	35,073,600
Dolomite do	25,350	2,111,850	82,000	7,580,000
Flagstones square meters	25,995	775,550	8,770	152,200
Limestone for industrial uses cubic meters	142,970	803,000	442,140	3,113,600
Marble do	3,360	1,185,100	10,970	6,114,200
Paving stones number	20,568,000	8,500,450	59,563,000	35,949,300
Rubble cubic meters	766,610	8,348,700	2,815,430	43,180,600
Zinc: Ore tons				
Crude zinc do	19,860	29,538,250	84,260	181,777,500
Sheet zinc do	21,305	40,670,600	57,130	165,285,200

[a] Statistique des industries extractives et métallurgiques et des appareils à vapeur en Belgique.
[b] Estimated copper content of copper matte made from foreign material.
[c] Includes some gold, which is extracted abroad.

BOLIVIA.

Mineral production of Bolivia, 1919 and 1920, in kilograms.[a]

[Exports.]

Mineral.	1919		1920	
	Quantity.	Value (bolivianos).	Quantity.	Value (bolivianos).
Antimony ore	237,979	132,227	1,100,117	674,680
Bismuth: Ore	93,830	306,204	153,005	500,532
Concentrates	38,289	248,703	27,014	175,385
Bars	169,451	2,211,335	194,537	2,541,853
Residues	72,506	315,401	63,175	274,811
Copper: Ore	9,875,757	1,777,035	15,753,740	2,977,860
Concentrates	2,843,959	1,697,459	1,921,490	1,269,529
Bars			5,083	5,165
Cement copper	84,187	73,794	53,228	26,715
Matte	87,222	61,164	1,000	6,858
Sulphide	10,075,000	1,706,591	10,322,000	1,881,097
Gold, fine[b]	7	(c)	7	(c)
Lead: Ore	4,759,295	1,815,841	4,384,858	1,650,340
Bars	9,986	4,289	35,510	19,220
Quartz	20,000	200	(c)	(c)
Silver, fine[b]	75,739	(c)	68,429	(c)
Sulphur	40,755	3,986	(c)	(c)
Tin: Concentrates	48,211,287	99,271,451	46,942,323	111,924,265
Bars	287,896	652,993	109,781	358,231
Tungsten concentrates	1,994,769	3,246,502	707,556	1,056,511
Vanadium ore	996	498		
Zinc ore	1,901,521	478,373	1,205,880	626,554

[a] Official data furnished by the American consul, La Paz. Data of production are not available, except where noted.
[b] Figures of production, published by the Director of the United States Mint.
[c] Data not available.

BRAZIL.

Mineral production of Brazil, 1919 and 1920.[a]

[Exports.]

Mineral.	1919		1920	
	Quantity.	Value.[b]	Quantity.	Value.[b]
Agate.....kilograms	410	$76	32,957	$9,909
Bort (carbonado)		605,957		633,926
Coal[c].....tons	(c)	(c)	[c] 281,874	[c] 3,312,250
Copper ore.....kilograms			105,000	1,408
Crystal.....do	27,169	35,963	39,626	48,486
Gems: Diamonds		1,365,372		1,083,528
Other		109,343		110,148
Gold, fine[d].....kilograms	3,009	2,000,000	2,708	1,800,000
Graphite.....do	2,160	540		
Iron: Ore.....do	100,000	1,250	17,100	397
Pig iron.....do	10,000	300	85,420	5,551
Manganese ore.....tons	205,725	4,228,335	453,737	8,368,946
Mica.....kilograms	154,350	316,637	68,133	118,983
Monazite.....do	146,185	14,070	1,158,080	117,639
Silver, fine[d].....do	778	28,022	622	20,388
Zircon.....do	207,615	17,279	541,506	23,366

[a] Data as reported by the Directoria de Estatistica Commercial, Brazil, furnished by the American consul general, Rio de Janeiro. Data of production are not available except as noted.
[b] Values converted to American dollars in the statement furnished, apparently at the rate of 4 milreis to the dollar.
[c] Figures for 1920 represent production and are unofficial and incomplete; figures for 1919 are not available.
[d] Figures of production, published by the Director of the United States Mint.

BRITISH BORNEO.

British Borneo now consists of the States of Brunei, North Borneo, and Sarawak; the colony of Labuan, which was formerly included, was annexed to the Straits Settlements in 1906.

Coal is the principal mineral product of all three States, the output for 1919 having been as follows: Brunei (Brooketon Collieries), 26,696 tons; North Borneo, 68,545 tons; Sarawak, 23,547 tons.[1] Similar data for 1920 are not yet available. In addition to coal the following minerals and metals are reported to occur: Antimony, gold, iron, and petroleum in Brunei; copper, gold, iron, and manganese in North Borneo; antimony, diamonds, gold, petroleum, quicksilver, and silver in Sarawak. No figures of production of these minerals are available for Brunei or North Borneo. The output of gold, petroleum, and silver in Sarawak for the years under review is reported as follows:

	1919	1920
Gold, fine [a] ..... kilograms..	671	509
Petroleum [b] ..... metric tons..	86,510	151,019
Silver, fine [a] ..... kilograms..	195	161

[a] Director of the United States Mint.
[b] Mineral industry of the British Empire and foreign countries—Statistical summary, London, Imperial Mineral Resources Bureau.

BRITISH GUIANA.

Mineral production of British Guiana, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Bauxite ..... tons..	1,999	[b] $7,320	[c] 31,883	Not stated.
Diamonds ..... grams..	3,341	459,412	7,872	$1,016,782
Gold, crude ..... do....	504,405	287,045	394,765	224,657
Stone: Granite ..... tons..	4,306	Not stated.	6,134	Not stated.

[a] British Guiana Lands and Mines Dept. Rept.
[b] Value stated in Foreign Commerce and Navigation of the United States for 1920.
[c] Dehydrated ore.

[1] Statistical abstract for British overseas dominions.

BRITISH INDIA.

Mineral production of British India, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Alum ..... kilograms..	94,136	4,800	136,708	7,320
Amber ..... do....	356	616	3,658	1,666
Antimony ore ..... tons .	6	200	kg. 9	40
Asbestos ..... do....	394	1,656	1,847	7,272
Barytes ..... do....	2,632	1,561	689	1,553
Bauxite ..... do....	1,709	1,934	3,995	4,128
Building stone and road metal ..... do....	2,769,510	412,680	1,970,526	454,750
Chromite ..... do....	37,024	88,724	27,231	79,970
Clay ..... do....	178,832	49,960	159,036	40,812
Coal ..... do....	22,991,217	10,119,256	18,250,508	9,381,164
Copper: Ore ..... do....	33,276	52,416	28,619	42,250
Refined metal ..... do....	996	(b)	520	(b)
Corundum ..... kilograms..	717,884	5,347	213,470	575
Gems: Diamonds ..... grams..	62	20,825	17	4,125
Rubies ..... do....	17,769	87,434	17,698	55,464
Sapphires ..... do....	9,457	20,170	6,603	6,083
Spinel ..... do....	4,489	483	6,820	435
Gold, crude ..... do....	15,777,583	2,256,039	15,522,752	2,783,915
Graphite ..... tons..	129	819	102	560
Gypsum ..... do....	28,773	2,869	34,089	3,693
Iron: Ore ..... do....	572,798	45,887	566,961	67,743
Pig iron ..... do....	360,037	(b)	316,252	(b)
Jadeite ..... kilograms..	102,569	28,045	174,200	48,351
Lead: Ore, slag, and gossan flux ..... tons..	70,276	(b)	96,301	(b)
Work lead ..... do....	19,396	668,150	24,203	975,621
Lime ..... do....	19,278	23,503	61,759	25,105
Magnesite ..... do....	17,401	19,728	14,577	17,216
Manganese ore ..... do....	546,630	1,546,330	748,259	3,823,695
Mica ..... kilograms..	2,325,922	219,843	2,385,310	235,077
Mineral paint ores: Ocher ..... tons....	2,747	3,600	2,687	3,343
Molybdenite ..... kilograms..	254	101	51	19
Monazite ..... tons....	2,056	60,712	1,667	49,231
Petroleum ..... hectoliters..	13,887,596	1,834,308	13,318,056	7,954,633
Phosphate rock (apatite) ..... tons..	508	500	(b)	(b)
Potash: Saltpeter ..... do....	17,832	471,247	15,260	540,012
Other salts ..... do....	84	42	51	25
Pyrites ..... do....	102	(b)	(b)	(b)
Salt ..... do....	1,921,491	1,823,522	1,656,286	1,446,409
Samarskite ..... kilograms..	152	10	152	12
Silver ..... grams..	67,357,916	487,246	90,399,064	843,109
Steatite ..... tons..	2,169	6,498	3,740	10,585
Tin: Ore ..... kilograms..	1,366,119	192,332	2,151,620	(b)
Block tin ..... do....	139,299	48,818	167,545	59,564
Tungsten ore ..... tons..	3,634	539,544	2,384	139,707

[a] Data for 1919 compiled from India Geol. Survey Rec., Calcutta; those for 1920 represent official data furnished by the Director of the Geological Survey of India through the American consul general, Calcutta.
[b] Data not available.

BULGARIA.

Mineral production of Bulgaria, 1919 and 1920, in tons.[a]

Mineral.	1919	1920	Mineral.	1919	1920
Coal: Bituminous	19,268	32,334	Lead ore [c]	(d)	478
Lignite	558,471	724,916	Oil shale [e]	(e)	(e)
Copper ore [b]	201	4,475	Other minerals [f]	(f)	(f)

[a] Data furnished by the Ministry of Commerce, Bulgaria, except where otherwise noted. Values not stated.
[b] Average metal content; 1919, 4.18 per cent Cu; 1920, 4 per cent Cu.
[c] Average metal content, 1920, 8 per cent Pb.
[d] Data not available.
[e] Rich deposits of oil shale have been reported at various localities and concessions for exploitation have been granted, but no data of production are available. (American consul, Sofia, Bulgaria.)
[f] Deposits of alluvial gold, chromium ores, iron ore, manganese ore, and iron pyrites are reported to occur in Bulgaria (Doelter, C. Die Mineralschätze der Balkanländer und Kleinasiens, Stuttgart, 1916). No data of exploitation are available.

CANADA.

Mineral production of Canada, 1919 and 1920.[a]

[Shipments.]

Mineral.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Abrasives: Corundum ..... tons.	(b)	(b)	178	$24,547
Grindstones ..... do.	1,833	$60,516	2,217	88,136
Tripoli ..... do.	513	11,300	236	8,600
Actinolite ..... do.	73	880	91	1,160
Ammonium sulphate ..... do.	10,673	(c)	18,084	(c)
Arsenic [d] ..... do.	3,074	509,924	2,231	447,848
Asbestic ..... do.	20,385	65,917	19,011	57,602
Asbestos ..... do.	124,070	10,909,452	162,038	14,734,599
Barytes, ground ..... do.	425	8,154	681	22,983
Cement, Portland and puzzolan ..... do.	793,037	9,802,433	1,056,055	14,798,070
Chromite ..... do.	7,748	228,898	9,993	251,379
Clay and clay products	.....	7,892,622	.....	10,649,907
Coal: Anthracite ..... tons.	100,991	44,357,443	141,229	65,974,658
Bituminous ..... do.	9,655,028		11,671,642	
Lignite ..... do.	2,655,309	10,055,906	3,275,304	14,719,065
Cobalt [f] ..... kilograms.	240,571	1,325,928	247,671	1,365,058
Coke ..... tons.	1,028,452	9,720,387	1,203,991	14,515,674
Copper: Ores and concentrates ..... do.	985,152	9,265,569	895,846	5,522,350
Metal [g] ..... kilograms.	34,043,554	14,028,265	37,013,257	14,244,217
Feldspar ..... tons.	13,316	86,231	34,358	280,895
Fluorspar ..... do.	4,593	97,837	10,192	240,446
Gold, fine ..... grams.	23,849,029	15,850,423	23,794,380	15,814,098
Graphite ..... tons.	1,234	100,221	1,986	165,617
Gypsum ..... do.	271,304	1,215,287	389,310	1,893,991
Iron: Ore ..... do.	178,869	693,386	117,092	517,987
Pig iron [h] ..... do.	832,592	24,577,589	989,185	30,319,024
Kaolin ..... do.	689	13,744	620	15,022
Lead: Ore and concentrates ..... do.	49,449	3,044,839	63,043	2,985,848
Metal [i] ..... kilograms.	19,879,806	3,053,037	16,308,246	3,214,262
Lime ..... tons.	226,942	2,310,607	299,330	3,818,553
Magnesite: Crude ..... do.	1,486	14,664	3,897	39,779
Calcined and dead burned ..... do.	8,741	313,801	12,775	472,977
Magnesium sulphate ..... do.	669	9,115	1,766	39,886
Manganese ore ..... do.	600	14,159	589	11,029
Mica ..... do.	2,498	273,788	1,999	376,022
Mineral pigments: Iron oxide [j] ..... do.	10,761	113,427	17,353	157,909
Mineral water	.....	71,015	.....	24,582
Molybdenite ..... kilograms.	37,649	69,203	.....	.....
Natural gas ..... cubic meters.	564,578,123	4,176,037	477,014,802	4,232,642
Nickel: Ores (nickel-copper) ..... tons.	519,270	4,579,200	1,030,368	9,086,336
Metal [k] ..... kilograms.	20,205,113	17,817,953	27,821,263	24,534,282
Palladium: Crude, recovered in Canada from Sudbury mattes ..... grams.	1,928	3,534	5,412	11,096
Fine, recovered in the United States from Sudbury mattes ..... grams.	23,701	(c)	22,985	(c)
Peat ..... tons.	894	6,561	4,128	18,650
Petroleum ..... hectoliters.	382,403	736,324	312,090	822,235
Phosphate rock ..... tons.	22	331	.....	.....

[a] Canada, Dept. of Mines, Mines Branch, Annual report on the mineral production of Canada.

[b] 26 tons of grain corundum were produced in 1919, but there were no shipments.

[c] Data not available.

[d] Figures represent white arsenic produced and estimated content of concentrates. Production of white arsenic was as follows: 1919, 2,594 tons; 1920, 1,661 tons.

[e] Exclusive of kaolin.

[f] Figures represent cobalt content of smelter products shipped and cobalt residues exported.

[g] For 1919, figures include 3,145,193 kilograms of refined copper; 10,508,330 kilograms of copper contained in blister copper exported; 10,975,691 kilograms contained in nickel-copper matte partly exported and partly refined in Canada; 18,799 kilograms contained in copper sulphate; and 9,395,541 kilograms, estimated recovery from ores and concentrates exported; for 1920, figures include 14,279,868 kilograms contained in blister copper partly exported and partly refined in Canada; 14,514,916 kilograms contained in nickel-copper matte partly exported and partly refined in Canada; 20,305 kilograms contained in copper sulphate; and 8,198,168 kilograms, estimated recovery from ores and concentrates exported.

[h] Pig iron made from foreign and domestic material, exclusive of ferroalloys. The production of pig iron from domestic ores, exclusive of ferroalloys, was as follows: 1919, 34,887 tons; 1920, 68,827 tons.

[i] Figures represent lead produced in Canada from domestic ores and estimated recovery from lead ores and bullion exported.

[j] Small quantity of zinc oxide included.

[k] Figures represent metallic nickel produced, estimated content of nickel-copper matte made from ores of Sudbury district and the Alexo mine, and the estimated content of nickel oxides and salts produced in smelters of eastern Ontario.

Mineral production of Canada, 1919 and 1920—Continued.

Mineral.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Platinum: Crude, from alluvial sands..grams..	778	$2,150	529	$719
Crude, recovered in Canada from Sudbury mattes.....grams..	778	1,447	2,768	5,665
Fine, recovered in the United States from Sudbury mattes.....grams..	19,191	(c)	15,210	(c)
Pyrites.....tons..	160,105	522,704	158,524	719,110
Quartz.....do....	86,174	527,635	116,387	467,821
Salt.....do....	*l* 134,536	1,397,929	190,376	1,544,724
Sand-lime brick.....number..	33,553,699	484,854	45,459,000	724,918
Sand and gravel.....tons..	9,402,450	2,680,460	10,460,507	4,291,067
Silver, fine.....grams..	498,298,201	17,802,474	414,620,506	13,450,330
Slate.....	.....	10,863	.....	14,200
Sodium sulphate.....tons..	(*l*)	(*l*)	736	19,496
Stone: Granite.....	.....	850,563	.....	1,508,916
Limestone.....	.....	3,074,815	.....	5,665,693
Marble.....	.....	213,982	.....	240,593
Sandstone.....	.....	86,577	.....	165,149
Strontium ore.....tons..	44	336	68	2,625
Sulphuric acid (66° Baumé).....do....	57,693	(c)	75,124	(c)
Talc: Crude.....do....	11,107	49,074	10,723	48,939
Refined.....do....	5,805	67,221	8,937	117,995
Tar.....hectoliters..	563,145	(c)	637,293	(c)
Zinc: Ore and concentrates.....tons..	122,955	1,049,493	226,011	1,157,844
Metal *m*.....kilograms..	14,603,197	2,362,448	18,081,872	3,057,961

c Data not available.
l Small quantity of sodium sulphate included under salt.
m Figures represent refined zinc made in Canada and estimated recovery from ores and concentrates exported.

Mineral production of Canada, 1919 and 1920, by Provinces.

Province and mineral.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
ALBERTA.				
Cement.....	(*a*)	(*a*)	(*a*)	(*a*)
Clay products.....	.....	$571,949	.....	$786,430
Coal: Anthracite.....tons..	100,991	18,294,495	141,229	15,949,863
Bituminous.....do....	2,092,309		3,094,275	
Lignite.....do....	2,310,427		2,963,711	13,899,745
Coke.....do....	513	3,602	.....	.....
Gold, fine.....grams..	747	500	.....	.....
Lime.....tons..	3,463	41,276	4,427	72,477
Natural gas.....cubic meters..	233,072,771	1,365,127	159,522,267	1,181,345
Petroleum.....hectoliters..	26,139	97,841	17,544	75,986
Sand-lime brick.....number..	729,000	10,206	2,257,000	40,626
Stone.....	.....	3,189	.....	4,415
Other products.....	.....	702,999	.....	1,575,569
BRITISH COLUMBIA.				
Arsenic *b*.....tons..	481	21,218	570	22,231
Cement.....	(*a*)	(*a*)	(*a*)	(*a*)
Clay products.....	.....	293,478	.....	596,172
Coal, bituminous.....tons..	2,209,830	12,420,445	2,593,516	16,726,950
Coke.....do....	91,041	890,217	137,271	2,002,075
Copper.....kilograms..	20,185,689	8,317,884	20,556,595	7,911,019
Fluorspar.....tons..	1,486	38,556	6,783	171,971
Gold, fine.....grams..	5,202,119	3,457,406	3,881,963	2,580,010
Iron ore.....tons..	1,089	6,000	(*c*)	(*c*)
Lead.....kilograms..	18,170,867	2,790,587	14,874,452	2,931,670
Lime.....tons..	11,153	187,963	17,822	341,632
Magnesium sulphate.....do....	669	9,115	1,764	39,783
Manganese ore.....do....	559	10,559	533	6,889
Mineral water.....	.....	1,800	.....	.....
Platinum, placer.....grams..	778	2,150	529	719

a Included under "Other products."
b Figures represent estimated content of concentrates.
c Data not available.

Mineral production of Canada, 1919 and 1920, by Provinces—Continued.

Province and mineral.		1919		1920	
		Quantity.	Value.	Quantity.	Value.
BRITISH COLUMBIA—continued.					
Pyrites	tons	6,105	$33,650	10,228	$56,376
Quartz	do	29,678	340,313	32,546	141,200
Silver	grams	115,503,928	4,126,556	103,482,152	3,356,971
Stone			217,006		276,505
Talc	tons	91	500	109	3,100
Zinc	kilograms	13,741,516	2,223,048	17,567,433	2,970,960
Other products			373,193		1,270,298
MANITOBA.					
Cement		(a)	(a)	(a)	(a)
Clay products			131,737		206,764
Copper	kilograms	1,518,619	625,775	1,389,154	534,604
Gold, fine	grams	22,519	14,966	24,292	16,145
Gypsum	tons	29,849	371,337	40,252	487,894
Lime	do	15,128	147,131	19,222	210,984
Natural gas	cubic meters			5,663	60
Sand-lime brick	number	7,389,300	124,847	10,278,800	197,734
Silver	grams	645,748	23,069	482,415	15,649
Stone			89,067		374,286
Other products			1,340,449		2,179,341
NEW BRUNSWICK.					
Abrasives: Grindstones	tons	1,576	51,516	2,026	79,696
Clay products			52,941		73,484
Coal, bituminous	tons	162,483	794,761	150,635	1,055,286
Gypsum	do	38,473	315,656	44,819	428,183
Lime	do	14,876	223,193	22,285	365,030
Natural gas	cubic meters	19,337,407	120,510	19,326,420	130,506
Petroleum	hectoliters	6,718	13,141	8,186	19,963
Stone			125,294		280,167
Other products			73,933		59,472
NOVA SCOTIA.					
Abrasives: Grindstones	tons	257	9,000	191	8,440
Tripoli	do	513	11,300	236	8,600
Barytes, ground	do	425	8,154	681	22,983
Cement		(a)	(a)	(a)	(a)
Clay products			432,900		541,114
Coal, bituminous	tons	5,189,408	22,078,726	5,832,524	32,238,129
Coke	do	347,679	3,939,906	389,741	4,349,986
Gold, fine	grams	26,438	17,571	21,461	14,263
Gypsum	tons	148,643	250,174	236,466	573,752
Iron, pig	do	258,625	7,141,641	301,631	(c)
Lime	do	11,638	73,309	6,398	40,300
Manganese ore	do	41	3,600	56	4,140
Salt	do	158	2,188	2,742	32,000
Stone			413,194		420,175
Other products			145,099		266,121
ONTARIO.					
Abrasives: Corundum	tons			178	24,547
Actinolite	do	73	880	91	1,160
Arsenic, white	do	2,593	488,706	1,661	425,617
Cement	do	321,212	3,650,585	323,167	4,377,814
Clay products			4,574,796		5,613,488
Cobalt	kilograms	240,571	1,325,928	247,671	1,365,058
Coke	tons	589,219	4,886,662	676,979	8,163,613
Copper	kilograms	11,043,385	4,550,627	14,542,092	5,596,392
Feldspar	tons	12,477	73,158	33,769	270,843
Fluorspar	do	3,107	59,281	3,409	68,475
Gold, fine	grams	15,730,243	10,454,553	17,573,311	11,679,483
Graphite	tons	1,216	99,821	1,775	133,704
Gypsum	do	54,339	278,120	67,773	404,162
Iron: Ore	do	177,489	686,381	(c)	(c)
Pig iron	do	566,981	17,104,151	679,539	(c)
Lead	kilograms	674,754	103,625	1,023,081	201,643
Lime	tons	113,633	1,143,973	162,238	1,962,086
Mica	do	295	55,351	1,330	94,562
Mineral water			55,958		14,473
Natural gas	cubic meters	312,167,945	2,690,400	298,160,452	2,920,731
Nickel	kilograms	20,205,113	17,817,953	27,821,263	24,534,282
Peat	tons	453	1,750	4,128	18,650

a Included under "Other products."

c Data not available.

Mineral production of Canada, 1919 and 1920, by Provinces—Continued.

Province and mineral.		1919		1920	
		Quantity.	Value.	Quantity.	Value.
ONTARIO—continued.					
Petroleum	hectoliters.	349,546	$625,342	286,360	$726,286
Phosphate rock	tons.	2	31		
Pyrites	do.	106,150	285,832	134,854	618,283
Quartz	do.	54,481	179,549	82,039	321,063
Salt	do.	134,364	1,395,291	187,634	1,512,724
Sand-lime brick	number.	24,141,399	335,200	30,664,700	451,175
Silver	grams.	376,908,188	13,465,628	308,161,657	9,996,795
Stone			1,936,268		4,035,478
Strontium ore	tons.	44	336	68	2,625
Talc	do.	16,821	115,795	19,424	162,784
Zinc	kilograms.	66,992	10,838	6,328	1,070
Other products			1,192,516		1,931,924
QUEBEC.					
Asbestic	tons.	20,385	65,917	19,011	57,602
Asbestos	do.	124,070	10,909,452	162,038	14,734,599
Cement	do.	358,860	4,340,010	478,411	6,545,054
Chromite	do.	7,748	228,898	9,993	251,379
Clay products			1,563,832		2,361,007
Copper	kilograms.	1,220,926	503,105	399,449	153,724
Feldspar	tons.	839	13,073	589	10,052
Gold, fine	grams.	45,722	30,388	29,704	19,742
Graphite	tons.	18	400	211	31,913
Iron: Ore	do.	291	1,005	871	3,000
Pig iron	do.	6,986	331,797	8,015	(c)
Kaolin	do.	689	13,744	620	15,022
Lead	kilograms.	1,034,185	158,825	410,713	80,949
Lime	tons.	57,051	493,762	66,938	826,044
Magnesite: Crude	do.	1,486	14,664	3,897	39,779
Calcined, etc	do.	8,741	313,801	12,775	472,977
Mica	do.	2,203	218,437	669	281,460
Mineral paints—iron oxide [d]	do.	10,761	113,427	17,353	157,909
Mineral water			13,257		10,109
Molybdenite	kilograms.	37,649	69,203		
Peat	tons.	441	4,811		
Phosphate rock	do.	20	300		
Pyrites	do.	47,850	203,222	13,442	44,451
Quartz	do.	2,015	7,773	1,802	5,558
Silver	grams.	4,383,289	156,600	1,897,406	61,552
Slate			10,853		14,200
Stone			1,441,919		2,189,325
Talc	tons.			136	1,050
Zinc	kilograms.	794,689	128,562	508,111	85,931
Other products			248,707		431,826
SASKATCHEWAN.					
Clay products			270,989		471,448
Coal, lignite	tons.	344,882	820,522	311,593	819,320
Magnesium sulphate	do.			2	103
Sand-lime brick	number.	1,294,000	14,601	2,258,500	35,383
Sodium sulphate	tons.	14	450	736	19,496
Other products			415,402		491,718
YUKON.					
Coal, bituminous	tons.	998	4,400	692	4,430
Copper	kilograms.	74,926	30,874	125,967	48,478
Gold, fine	grams.	2,821,241	1,875,039	2,263,649	1,504,455
Silver	do.	857,088	30,621	596,876	19,363

[c] Data not available.
[d] Small quantity of zinc oxide included.

CEYLON.

Mineral production of Ceylon, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (rupees).[b]	Quantity.	Value (rupees).[b]
Gems[c]	(c)	(c)	(c)	(c)
Graphite, exported.....tons..	6,779	1,732,079	9,353	2,100,114
Mica, exported.....kilograms..	8,484	23,036	14,021	36,523
Monazite sand.....tons..			65	44,160

[a] Official data furnished by the American consul, Colombo, through the courtesy of the inspector of mines of the Government of Ceylon.

[b] Legal value of one rupee=1 s. 4d., or 15 rupees to the pound sterling.

[c] No accurate data of the production or export of gems are available, but the annual value of the output may be roughly estimated at 5,000,000 rupees.

CHILE.

Mineral production of Chile, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pesos).	Quantity.	Value (pesos).
Borax.....tons..	10,116	2,276,100	15,823	4,079,170
Clay, exclusive of kaolin.....do....			5,738	153,778
Coal.....do....	1,485,491	92,100,442	1,063,185	71,233,395
Copper, fine.....kilograms..	79,579,873	106,121,567	98,951,942	107,546,811
Gold, fine.....grams..	1,984,384	2,589,387	1,654,418	1,761,031
Gypsum.....tons..	4,000	207,719	5,270	263,500
Iodine.....kilograms..	243,167	4,839,023	350,066	8,103,889
Iron ore.....tons..	748	22,440	3,100	93,000
Kaolin.....do....	650	23,014	650	26,132
Lead ore.....kilograms..	227,000	21,565	66,000	6,138
Lime.....tons..	17,603	311,632	21,228	375,735
Manganese ore.....kilograms..	150,000	3,865	11,632,808	549,701
Marble.....tons..			200	60,000
Molybdenum ore.....kilograms..	1,000	5,000		
Nitrates.....tons..	1,703,240	247,957,679	2,523,458	473,022,202
Phosphate rock (apatite).....do....	1,500	123,000	1,510	123,820
Potash, perchlorate of.....kilograms..	20,696	8,278	33,487	15,000
Quicksilver.....do....	2,635	105,400		
Salt.....tons..	29,454	1,472,700	33,951	2,017,453
Silver, fine.....grams..	41,355,712	3,799,456	81,007,663	8,079,907
Sulphur.....tons..	18,910	2,420,480	13,340	1,707,261

[a] Anuario estadístico de la República de Chile: Minería y metalurgía.

CHINA.

Mineral production of China, 1919 and 1920.[a]

[Exports.]

Mineral.		1919		1920	
		Quantity.	Value (haikwan taels).	Quantity.	Value (haikwan taels).
Alum, white	tons	3,305	261,929	4,513	326,790
Antimony: Ore	do	580	20,600	1,352	68,488
Crude	do	2,135	73,933	4,557	266,824
Regulus	do	6,208	541,465	9,726	793,733
Arsenic: Realgar	do	225	53,436	472	96,681
White arsenic	do	58	10,567	49	9,149
Asbestos	do	(b)	(b)	5	(b)
Bismuth ore	do	(b)	(b)	90	(b)
Brick and tile	number	70,012,507	550,453	78,851,471	473,253
Cement	tons	10,289	138,969	10,511	141,025
Coal [c]	do	18,292,252	(b)	19,484,896	(b)
Coke	do	39,128	442,805	19,410	202,543
Copper: Ore	do	(b)	(b)	206	(b)
Metal, ingots, and slabs	kilograms	553,561	186,372	191,234	79,969
Gold, unwrought			4,966,276		35,228,151
Gypsum	tons	4,178	53,405	5,286	59,165
Iron: Ore [c]	do	1,338,874	(b)	1,489,731	(b)
Pig iron	do	163,911	8,175,024	185,389	7,284,348
Lead: Ore	do	137	6,698	2,391	135,766
Metal, work lead	do	11	1,955	330	81,508
Manganese ore	do	(b)	(b)	25,324	(b)
Molybdenum	do	(b)	(b)	16	(b)
Potash	do	648	66,097	542	64,519
Quicksilver, metallic	kilograms	80,376	223,189	45,480	129,967
Salt	tons	431,818	3,260,877	341,633	1,729,399
Silver, unwrought			1,990,592		10,015,836
Soapstone [d]		(d)	(d)	(d)	(d)
Soda	tons	330	12,747	211	15,586
Stone: Marble, granite, etc			522,297		245,865
Tin: Tin compound	tons	20	4,471	14	4,101
Metal, slabs	do	8,831	8,428,133	11,487	11,098,167
Tungsten ores: Wolframite	do	2,360	(b)	4,190	(b)
Zinc: Ore	do	2	34	9,116	156,796
Metal, spelter	do	109	24,198	98	13,458

[a] Maritime Customs, Foreign Trade of China, Part II, Analysis, vol. 2, Exports. Data relate to exports of domestic products, except where otherwise stated.

[b] Data not available.

[c] Figures of production furnished by the Director of the Geological Survey of China through the American consul general at Tientsin.

[d] Data of the output and exports of unmanufactured soapstone are not available. The exports of soapstone ware were as follows: 1919, 15 tons, value 4,038 taels; 1920, 41 tons, value 10,451 taels.

COLOMBIA.

No recent official statistics covering the mineral production of Colombia are available.

Deposits of asphalt, coal, copper, emeralds, gold, iron, lead, manganese, petroleum, platinum, quicksilver, rock salt, silver, and zinc exist and are being more or less exploited.

Colombia takes high rank as a producer of platinum and emeralds, standing second only to Russia as a source of platinum and holding almost a monopoly in the emerald trade. The coal deposits of the country are extensive but have not been mined to any great extent. The petroleum lands are being actively prospected and it is generally believed that in time Colombia will hold an important place as an oil producer.

Gold, platinum, and silver produced in Colombia, 1919 and 1920.

		1919	1920
Gold [a]	kilograms	9,028	8,727
Platinum [b]	grams	1,089,000	1,089,000
Silver [a]	kilograms	15,376	14,930

[a] Director of the United States Mint.
[b] Hill, J. M., Platinum and allied metals in 1921: U. S. Geol. Survey Mineral Resources, 1921, pt. 1, p. 148, 1922.

CUBA.

Large deposits of asphalt, chromite, copper, iron, and manganese exist in Cuba, and all except asphalt have been intensively worked. Other mineral deposits reported to occur are antimony, barytes, coal, gold, graphite, gypsum, marble, petroleum, iron pyrites, and sulphur. Statistics of output are not available.

The bulk of the chromite, copper, iron, and manganese produced is shipped to the United States, which imported during 1920 the following quantities.[1]

	Tons.
Chromite	721
Copper ores and concentrates (copper content)	8,367
Iron ore	904,134
Manganese ore	8,379

CYPRUS.

Mineral production of Cyprus, 1919 and 1920. [a]

[Exports.]

Mineral.	1919		1920	
	Tons.	Value (pounds sterling).	Tons.	Value (pounds sterling).
Asbestos	1,352	25,355	911	29,484
Copperas			11	100
Gypsum	3,038	5,222	7,228	10,451
Pyrites, copper [b]			[c] 1,422	(d)
Salt	1,503	3,023	625	1,352
Sulphur			12	17
Umber	2,830	6,255	8,336	27,664

[a] Data furnished by the American consular agent, Skouriotissa, Cyprus.
[b] Production.
[c] Average content: Copper, 2 per cent; sulphur, 50 per cent.
[d] Value not stated.

CZECHOSLOVAKIA.

Statistics covering the mineral production of Czechoslovakia during 1919 and 1920 are not available.

Deposits of antimony, arsenic, barytes, bismuth, coal, cobalt, copper, fluorspar, gold, graphite, iron, kaolin, lead, manganese, mineral paint ores, mineral waters, nickel, peat, petroleum, iron pyrites, quicksilver, salt, silver, sulphur, tin, tungsten, uranium, and zinc are known to exist. Many of these deposits have been worked for a number of years; some were developed under the stress of war needs.

[1] Figures represent general imports. Monthly Summary of the Foreign Commerce of the United States, pt. 1, December, 1921.

The radium plant of Jachymov, Bohemia, is one of the most noted in the world. The output of radium from the State uranium mines was 0.9689 gram in 1919 and 2.2310 grams in 1920.[1]

Coal and iron ore produced in Czechoslovakia in 1919 and 1920, in tons.[a]

	1919	1920
Bituminous coal	9,865,605	11,143,221
Lignite	17,081,208	19,943,258
	26,946,813	31,086,479
Iron ore	520,042	563,569

[a] Information supplied by the American minister and the American vice consul in charge, Prague, Bohemia.

DENMARK.

Mineral production of Denmark in 1920.[a]

Mineral.	1920		Mineral.	1920	
	Tons.	Value (kroner).		Tons.	Value (kroner).
Cement, Portland	251,369	30,581,115	Kaolin [e]	(e)	(b)
Chalk: For blanching	14,438	(b)	Lime	47,654	(b)
Other	74,950	(b)	Marls for fertilizer: Crude	186,358	(b)
Clay [c]	(c)	(b)	Crushed	50,606	(b)
Coal, lignite [d]	(d)	(b)	Peat [f]	(f)	(b)
Flint: Pebbles	11,162	527,000	Stone for building	1,660	(b)
Other	7,746	37,039			

[a] Data furnished by the American consul general, Copenhagen, through the courtesy of the Statistical Bureau of Denmark. Similar data for 1919 are not available.

[b] Data not available.

[c] Exact data of production are not available, but output is estimated to have been between 600,000 and 800,000 tons.

[d] A small quantity of lignite was mined in the years 1918–1920, but owing to the low fuel value and the high cost of the product, it is not believed that the industry will continue.

[e] The latest statistics of production available relate to the year 1913, when about 60,000 tons was produced. The material is mined on the island of Bornholm. In 1920, 17,808 tons were exported.

[f] Exact data of production are not available. Pre-war production ran from 100,000 to 200,000 tons a year, but in the years 1918–1920, owing to the shortage and unusually high cost of coal, the annual output was from 1 to 2 million tons. Presumably production will now return to about the pre-war level.

ECUADOR.

No recent official statistics of the mineral output of Ecuador are available.

The principal mineral products of the country are gold, petroleum, silver, and salt. Coal and manganese are mined, but not on a commercially important scale. Deposits of copper, graphite, gypsum, iron, kaolin, lead, mica, quicksilver, sulphur, and zinc have also been reported, but these minerals remain practically undeveloped.

Development of the oil lands of the country is actively progressing, but no data of production are available.

Gold and silver produced in Ecuador in 1919 and 1920, in kilograms.[a]

	1919	1920
Gold, fine	1,204	1,129
Silver, fine	1,244	1,089

[a] Director United States Mint.

[1] Information supplied by the American consul, Prague, Bohemia.

EGYPT.

Mineral production of Egypt, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (Egyptian pounds).	Quantity.	Value (Egyptian pounds).
Gold, fine.....kilograms..	61	10,246	4	756
Magnesia, sulphate of.....tons..	269	(b)	266	(b)
Manganese ores.....do....	48,743	66,000	77,562	200,000
Nitrate of soda.....do....	3,940	(b)	4,743	(b)
Ocher.....do....	44	(b)	231	(b)
Petroleum.....do....	224,300	(b)	147,950	(b)
Phosphate rock.....do....	29,365	54,000	114,813	303,000
Sodium carbonate, crude.....do....	1,431	(b)	1,981	(b)

[a] Official data furnished by the American consul general, Cairo, Egypt, through the courtesy of the Ministry of Finance, Cairo.
[b] Value not stated.

ERITREA.[1]

Gold, iron, limestone, manganese, petroleum, and salt are reported in Eritrea, but none of these products are exploited on a commercial scale except salt. The most important mineral industry of the colony is based on the potash beds of Abyssinia, which lie about 10 miles inland from the Eritrean frontier. The mines are exploited by an Italian company under a 35-year lease from the Abyssinian Government. The potash is first brought to the port of Mersa Fatimari, on the Eritrean coast, and thence transported by sea to the port of Massawa for shipment abroad. The demand for potash for munition works stimulated the industry during the World War, but with the decline in demand and the lower prices after the armistice was declared production declined, and the operating company is now concerned in developing new demands and markets.

Three quartz gold mines have been worked in Eritrea in the past, but operations were not profitable and the mines are now closed. The natives bring in small quantities of gold panned from stream beds, but further development of the gold-mining industry is unlikely unless richer deposits are discovered than are now known.

Several apparently extensive deposits of iron ore have been reported, the most notable of which is at Mount Ghedem, near Massawa. The deposit also contains manganese, but neither metal has been exploited.

Deposits of rock salt on the Dankali coast supply the native traders with the blocks used as a medium of exchange in Abyssinian trade. The principal source of the salt of Eritrean commerce, however, is the marine salt obtained by solar evaporation from the waters of the Red Sea, one plant alone at Massawa yielding an annual average of more than 40,000 tons.

Traces of petroleum have been found in the Dahlac Archipelago, just off the entrance to the harbor of Massawa, but no development work has been reported.

Limestone occurs at various places in Eritrea, and local lime-burning operations supply the building needs of the colony.

[1] Southard, A. E., American consul, Aden, Arabia, 1920.

FEDERATED MALAY STATES.

Mineral production of the Federated Malay States, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Cement.....tons..	4,466	(b)	5,538	(b)
Coal.....do....	194,363	(b)	251,896	(b)
Gold, fine.....grams..	510,159	73,100	398,840	51,627
Stone: Limestone for cement.....tons..	6,895	(b)	7,490	(b)
Stone for roadmaking, etc.....do....	384,843	(b)	348,054	(b)
Tin: Concentrates (exports) c.....do....	44,873	7,521,315	43,597	9,123,616
Block tin (exports).....do....	5,219	1,215,114	4,105	1,193,093
Tungsten ores: Scheelite.....do....	232	(b)	122	(b)
Wolframite.....do....	211	(b)	262	(b)

[a] Data furnished by the senior warden of mines, Federated Malay States.
[b] Value not stated.
[c] The estimated content of metallic tin in concentrates exported was 32,309 tons in 1919 and 31,390 tons in 1920.

Metallic tin produced in the Federated Malay States, 1919 and 1920, by States.[a]

Mineral and State.	1919		1920	
	Tons.	Value (pounds sterling).	Tons.	Value (pounds sterling).
Block tin exported:				
Pahang	170	39,648	182	52,831
Perak	1,334	310,617	1,166	339,000
Selangor	3,715	864,847	2,757	801,262
	5,219	1,215,112	4,105	1,193,093
Tin in concentrates exported:				
Negri Sembilan	552	128,598	205	59,714
Pahang	3,044	708,588	3,025	879,120
Perak	20,927	4,871,636	21,096	6,131,547
Selangor	7,786	1,812,495	7,064	2,053,235
	32,309	7,521,317	31,390	9,123,616
Total metallic tin exported	37,528	8,736,429	35,495	10,316,709

[a] Data furnished by the senior warden of mines, Federated Malay States.

FINLAND.

Mineral production of Finland, 1919 and 1920.[a]

Mineral.	1919		1920	
	Tons.	Value (markkas).	Tons.	Value (markkas).
Copper: Ore	540	(b)	187	(b)
Metal	16	137,300	75	750,000
Graphite	30	(b)	27	(b)
Iron: Ore	8,262	169,100	12,893	984,300
Pig iron	7,186	5,771,000	12,961	23,308,200
Lime	72,212	992,800	128,080	2,491,400
Peat	.....	4,614,800	.....	5,752,600
Zinc ore	.....	.....	9,180	(b)

[a] Data furnished by the American consul, Helsingfors, through the courtesy of the Industristyrelsen, Finland.
[b] Data not available.

FRANCE.

Mineral production of France, 1919 and 1920.[a]

Mineral.	1919	1920 [b]
Abrasives:		
Diatomaceous earth ..... tons..	2,500	3,800
Millstones ..... do....	24,742	19,240
Tripoli ..... do....	34	(c)
Whetstones ..... do....	440	500
Aluminum ..... do....	10,255	(c)
Ammonium sulphate .. do....	8,400	(c)
Antimony:		
Ore ..... do....	4,123	5,600
Oxide ..... do....	477	(c)
Regulus ..... do....	1,547	(c)
Arsenic:		
Ore (realgar) ..... do....	600	280
White arsenic ..... do....	735	(c)
Asbestos [d] ..... do....	(d)	(c)
Asphalt ..... do....	18,117	25,000
Barytes ..... do....	11,861	13,320
Bauxite ..... do....	159,103	266,700
Briquets, fuel ..... do....	2,838,907	e 2,058,000
Cement ..... do....	1,185,704	(c)
Chalk ..... do....	24,300	48,320
Clay:		
For brick and tile .. do....	2,715,507	(c)
For pottery and faience ..... tons..	138,930	(c)
Refractory ..... do....	316,844	341,100
Other ..... do....	30	(c)
Coal:		
Anthracite and bituminous ..... tons..	21,546,487	24,293,000
Lignite ..... do....	894,894	967,800
Coke, metallurgical .... do....	1,667,253	f 782,000
Copper:		
Ore ..... do....	38	550
Metal ..... do....	873	(c)
Feldspar [g] ..... do....	(g)	(c)
Fluorspar ..... do....	4,894	9,000
Fuller's earth ..... do....	80	(c)
Gold-bearing ores ..... do....	12,165	7,000
Gold ..... kilograms..	51	(c)
Graphite ..... tons..	650	272
Gypsum:		
Agricultural ..... do....	19,974	43,086
Plaster ..... do....	825,863	1,455,000
Other ..... do....	3,740	(c)
Iron:		
Ore ..... do....	9,412,786	13,921,800
Pig iron ..... do....	2,447,295	e 3,434,000
Kaolin and feldspar .. do....	49,478	74,830
Lead:		
Ore ..... do....	4,348	h 4,808
Metal ..... do....	10,928	i 12,000
Lime:		
Agricultural ..... tons..	184,053	267,490
Hydraulic ..... do....	1,250,628	1,349,900
Other ..... do....	398,703	(c)
Manganese ore ..... do....	7,016	10,300
Marl ..... do....	260,415	506,360
Nickel, metallic [j] ..... do....	500	(c)
Ocher ..... do....	8,000	(c)
Oil shale, including boghead ..... tons..	49,127	69,000
Peat ..... do....	71,068	78,500
Petroleum, crude ..... do....	47,255	k 54,900
Phosphate rock ..... do....	103,869	124,930
Potash:		
Sylvinite, 12 to 16 per cent ..... tons..	285,552	646,850
Sylvinite, 16 to 22 per cent ..... tons..	170,454	330,540
Chloride ..... do....	35,531	62,243
Total in K_2O ..... do....	96,546	194,355
Pyrites, iron ..... do....	118,273	140,400
Quartz ..... do....	30,100	(c)
Salt:		
Marine ..... do....	597,495	826,556
Rock, and salt from springs ..... tons..	321,015	
Contained in brine for soda manufacture ..... tons..	328,000	
Sand, silica, and gravel ..... tons..	3,528,375	(c)
Shale oil ..... do....	3,234	(c)
Slate:		
Roofing slate ..... do....	162,687	(c)
Slabs ..... do....	730	445
Silver ..... kilograms..	5,108	(c)
Stone:		
Building stone, dressed ..... tons..	698,917	(c)
Limestone for industrial uses ..... tons..	1,600,825	(c)
Marble ..... do....	305,236	(c)
Other stone ..... do....	12,320,528	(c)
Sulphur rock ..... do....	2,222	1,100
Talc and asbestos ..... do....	38,160	(c)
Tar ..... do....	29,700	(c)
Tungsten ore ..... do....	11,526	3,745
Tin ore ..... do....	.....	18
Zinc:		
Ore ..... do....	17,847	k 4,247
Metal ..... do....	10,800	i 19,655
Zinc-lead ore ..... do....	2,102	k 1,247

[a] Data for 1919 compiled from Statistique de l'industrie minérale et des appareils à vapeur en France et en Algérie pour l'année 1919; those for 1920 furnished by Direction des Mines, Ministère des Travaux Publics, Paris, except where otherwise noted.
[b] Data for 1920 subject to revision.
[c] Data not available.
[d] Asbestos included with talc.
[e] Data reported by the American consul, Paris.
[f] Figures published in Revue de l'industrie minérale, Paris.
[g] Feldspar included with kaolin.
[h] Annales des mines, 1921, Paris.
[i] Figures of the American Bureau of Metal Statistics, New York.
[j] Smelted from New Caledonia ores.
[k] Figures published by the Imperial Institute, London.

GERMANY.

Mineral production of Germany in 1919.[a]

Mineral.	Quantity.	Value (marks).	Mineral.	Quantity.	Value (marks).
Arsenic ore.....tons..	26,068	1,244,000	Lead: Antimonial lead .....tons..	3,594	7,537,000
Asphalt, crude....do....	12,554	273,000	Soft lead...do....	53,992	102,728,000
Bauxite.....do....	9,393	288,000	Work lead..do....	10,009	26,596,000
Boracite.....do....	103	236,000	Litharge [d].....do....	350	1,407,000
Briquets (fuel) [b]...do....	23,691,975	1,076,499,000	Manganese ores [f]..do....	11,475	1,038,000
Cadmium.....do....	38	1,423,000	Petroleum.....do....	37,516	23,096,000
Coal: Bituminous [b] .....tons..	116,707,234	5,954,841,000	Potash, crude:		
Lignite.....do....	93,648,264	1,002,025,000	Carnallite.....do....	3,277,729	65,185,000
Cobalt - nickel-bismuth-tin ores [c].....tons..	123,299	5,114,000	Kainite, sylvinite, and other crude salts.....tons..	4,610,423	186,963,000
Coke.....do....	22,709,532	1,803,805,000	Pyrites, iron.....do....	381,384	13,677,000
Copper: Ore.....	616,809	81,580,000	Salt: Rock.....do....	1,487,849	46,871,000
Blister [d]..do....	1,865	14,338,000	Brine.....do....	291,719	34,846,000
Electrolytic .....tons..	15,236	90,201,000	Silver, fine...kilograms..	294,337	173,403,000
Cement [d]..do....	1,655	9,094,000	Silver, bullion.....do....	17,190	6,480,000
Refined..do....	17,931	134,106,000	Tin, metallic.....tons..	799	23,690,000
Gold, fine....kilograms..	13,236	98,629,000	Tungsten ores: Wolfram [e] .....tons..	20,583	471,000
Graphite.....tons..	30,525	5,481,000	Zinc: Crude [d].....do....	61,137	112,284,000
Iron: Ore [e].....do....	6,142,359	217,226,000	Dust and oxide [d] .....tons..	16,441	17,939,000
Pig iron.....do....	5,604,408	2,527,567,000	Refined.....do....	36,267	76,338,000
Lead-zinc-silver ores .....tons..	1,703,413	112,759,000			

[a] Statistics published by the Statistisches Reichsamt, Berlin. A similar official statement for 1920 is not available. The data issued by the Reichsamt do not cover all minerals produced in Germany, as is evident from the table given below.
[b] Includes the Saar district and the Bavarian Palatinate.
[c] Includes some tin-wolfram ore.
[d] Production destined for sale.
[e] Exclusive of ores with an average content of manganese above 30 per cent, which are listed under manganese.
[f] Averaging above 30 per cent Mn.

Mineral production of Bavaria, Prussia, and Saxony, 1919 and 1920.

State and mineral.	1919		1920	
	Quantity.	Value (marks).	Quantity.	Value (marks).
BAVARIA.[a]				
Abrasives: Emery.....tons..	170	7,600	140	22,400
Whetstones.....do....	14	5,000	15	6,040
Asbestos.....do....	12	28,330	28	28,000
Asphalt and oil shale.....do....	55	2,725	1,069	82,993
Barytes.....do....	8,804	217,360	7,888	418,500
Briquets, fuel [b].....do....	137,110	(c)	121,963	(c)
Cement marl.....do....	98,639	668,350	32,097	1,705,463
Chalk.....do....	13,829	554,135	26,461	2,210,390
Clay, fire.....do....	202,062	4,558,937	455,446	23,673,609
Coal: Bituminous.....do....	603,790	34,693,098	[d] 92,178	20,582,030
Lignite.....do....	2,046,992	66,956,698	2,437,633	208,208,457
Copper ore.....do....	2,555	12,000	2,000	10,000
Feldspar.....do....	6,527	395,814	5,850	801,200
Fluorspar.....do....	6,398	258,930	6,272	844,472
Graphite.....do....	30,451	5,475,511	20,447	4,831,105
Gypsum.....do....	33,700	296,780	48,580	1,316,050
Iron: Ore.....do....	376,486	12,658,248	451,326	27,252,686
Pig iron [e].....do....	159,690	68,209,500	161,797	193,335,600
Kaolin.....do....	128,424	881,836	194,485	4,530,015
Mineral paint ores, ocher, etc.....do....	4,585	102,040	10,608	423,031
Petroleum.....do....	87	17,400	90	82,000
Phosphorite.....do....	701	42,260	4,934	1,356,850
Pyrites, iron.....do....	7,396	216,000	7,771	976,335

[a] Official statistics, published in Glückauf, Berg- und hüttenmännische Zeitschrift, Essen, Germany.
[b] Data published in Stahl und Eisen, Zeitschr. deutsche Eisenhüttenwesen, Düsseldorf, Germany.
[c] Data not available.
[d] Exclusive of the Bavarian Palatinate (Saar).
[e] Statistisches Jahrb. Freistaat Bayern, Jg. 1921.

Mineral production of Bavaria, Prussia, and Saxony, 1919 and 1920—Continued.

State and mineral.		1919		1920	
		Quantity.	Value (marks).	Quantity.	Value (marks).
BAVARIA—continued.					
Quartz and quartz sand	tons	163,864	1,206,623	274,091	4,082,790
Salt: Brine	do	36,733	4,394,426	41,062	13,458,129
Rock	do	2,499	114,779	1,452	136,749
Slate, roofing and slabs	do	445	93,120	306	285,700
Soapstone	do	5,371	473,200	20,943	1,447,421
Stone: Basalt	do	234,379	1,822,837	525,164	10,213,557
Granite	do	78,478	2,913,684	491,495	17,985,306
Lithographic stone	do	3,283	2,653,000	1,878	3,044,000
Sandstone	do	132,696	3,264,199	256,224	9,190,356
Other	do	1,081,457	12,486,851	1,339,540	34,964,519
Tin ore	do	.....	.....	24	12,000
Zinc-lead ore	do	192	600	.....	.....
PRUSSIA.[f]					
Amber, crude	tons	157	6,646,312	290	17,069,591
Arsenic ore	do	5,117	2,164,434	6,009	7,236,578
Boracite	do	66	175,272	89	453,945
Briquets, fuel[b]	do	19,327,677	(c)	24,047,295	(c)
Coal: Bituminous	do	112,028,796	5,713,045,359	[g] 127,036,799	19,904,111,851
Lignite	do	75,953,982	740,602,723	91,969,783	2,665,898,969
Coke[b]	do	21,718,408	(c)	25,104,399	(c)
Copper ore	do	615,808	82,507,140	574,201	198,588,503
Graphite	do	36	8,000	40	9,846
Iron ore	do	4,625,906	201,168,927	4,530,978	732,384,434
Lead ore	do	99,230	64,258,522	91,377	200,211,086
Manganese ore	do	553	454,641	766	553,582
Nickel ore	do	29,151	1,523,384	16,050	1,965,852
Petroleum	do	37,353	23,032,879	34,955	54,230,721
Potash: Carnallite	do	2,027,375	36,766,341	3,498,593	145,867,697
Kainite, sylvinite, and other potash salts	do	3,372,753	133,803,647	4,171,890	331,078,815
Pyrites, iron	do	348,585	14,371,734	398,426	35,180,157
Salt: Brine	do	142,471	18,535,785	167,918	68,623,285
Rock	do	780,923	25,033,260	1,476,228	148,214,487
Zinc ore	do	313,347	77,970,021	316,658	287,732,283
SAXONY.[h]					
Bismuth ores[i]	tons	66	455,015	31	
Briquets, fuel	do	1,505,499	60,833,471	1,808,252	
Coal: Bituminous	do	3,932,304	250,806,176	4,056,234	
Lignite	do	6,712,010	70,363,164	7,656,211	
Cobalt-bismuth-nickel ores	do	122	1,163,599	131	
Coke	do	135,328	13,969,884	144,588	
Fluorspar	do	2,906	134,015		
Iron ore	do	2,675	92,928		
Manganese ore	do	30	604		
Mineral paint ores	do	29	1,211		(c)
Molybdenite	kilograms	305	9,180		
Pyrites: Arsenical	tons	157	23,072		
Iron	do	134	1,687	(c)	
Quartz		.....	15		
Sand and gravel		.....	11,175		
Silver-lead ore[j]	tons	262	376,427		
Stone: Limestone		.....	55,881		
Tin ore[i]	tons	273	3,546,728		
Tungsten ore: Wolframite	do	250	2,822,574		

[b] Data published in Stahl und Eisen, Zeitschr. deutsche Eisenhüttenwesen, Düsseldorf, Germany.
[c] Data not available.
[f] Zeitschr. Berg-, Hütten-, und Salinenwesen preuss. St., Berlin, Germany.
[g] Exclusive of the output of the Saar mines.
[h] Jahrb. Berg- und Hüttenwesen in Sachsen, Jg. 1920, Freiberg, Germany.
[i] Tin-bismuth ores included under tin ore.
[j] Includes some silver-bearing pyrites.

GOLD COAST COLONY AND ASHANTI.

Mineral production of the Gold Coast Colony and Ashanti, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Diamonds, rough.....grams..	.....	.....	20	764
Gold, fine.....do....	9,182,556	1,254,258	6,454,159	881,484
Manganese ore.....tons..	35,754	50,785	41,628	42,130
Tin ore, crude [b].....do....	.....	.....	3	86

[a] Government of the Gold Coast, Report on the Mining Department.
[b] Data furnished by the American consul, Dakar, Senegal.

GREECE.

Mineral production of Greece, 1919 and 1920.[a]

Mineral.	1919			1920		
	Production (quantity).	Shipments.		Production (quantity).	Shipments.	
		Quantity.	Value (drachmas).		Quantity.	Value (drachmas).
Antimony ore [b].....tons..	159	.....	.....	146	33	6,734
Arsenic, white.....do....	686	1,018	1,024,278	969	862	2,005,617
Chrome ore.....do....	9,054	4,070	728,555	4,402	7,224	(c)
Coal, lignite.....do....	182,951	182,006	13,860,744	182,880	181,961	18,739,289
Copper ore [d].....do....	4	.....	.....	27	.....	.....
Emery.....do....	9,300	5,543	1,218,153	11,089	11,089	2,278,752
Gypsum.....do....	521	471	3,890	1,147	1,142	25,400
Iron ore.....do....	46,939	31,384	609,807	44,751	57,402	1,094,633
Lead: Ore.....do....	3,334	.....	.....	23,582	.....	.....
Metal, work lead.....do....	3,841	5,221	3,602,318	5,016	5,296	4,888,857
Magnesite: Crude.....do....	62,408	28,017	1,440,009	79,323	73,683	4,623,763
Calcined.....do....	3,532	3,408	678,057	2,394	3,591	1,022,116
Dead burned.....do....	5,578	5,290	1,401,636	.....	.....	.....
Manganiferous iron ore.....do....	418	.....	.....	4	.....	.....
Millstones.....number..	36,178	9,200	30,922	2,728	2,728	15,211
Nickel ore [e].....tons..	1,096	.....	.....	.....	.....	.....
Pyrites.....do....	2,354	2,307	80,745	3,239	2,674	106,960
Salt, marine.....do....	28,831	42,991	9,830,788	57,285	48,556	12,120,250
Santorini earth.....do....	5,732	5,732	40,124	10,388	10,388	77,910
Stone: Marble.....cubic meters..	450	150	90,000	1,316	1,250	687,550
Sulphur, crude.....tons..	2,238	843	43,820	.....	.....	.....
Zinc: Ores [f].....do....	3,334	.....	.....	2,591	.....	.....
Calcined calamine [g].....do....	2,250	.....	.....	1,154	11,020	1,540,932
Zinc-lead ores [h].....do....	2,493	.....	.....	2,636	.....	.....

[a] Data furnished by the Direction du Service des Mines, Athens.
[b] Average metal content 25–60 per cent Sb.
[c] Data not available.
[d] Average metal content not stated for 1919; in 1920, 6 per cent Cu.
[e] Average metal content in 1919, 5–6 per cent Ni.
[f] Average metal content 26 per cent Zn in 1919; content for 1920 not stated.
[g] Average metal content not stated for 1919; 36 per cent Zn in 1920.
[h] Average metal content: 1919, Zn 11 per cent, Pb 10 per cent, Ag 74 grams; 1920, Zn 11 per cent, Pb 11 per cent, Ag 100 grams.

GREENLAND.

Mineral production of Greenland, 1919 and 1920.[a]

Mineral.	1919	1920
Coal.....tons..	2,160	2,308
Cryolite.....cubic meters..	3,395	5,247
Graphite.....do....	(b)	600

[a] Official data furnished by the American consul general at Copenhagen, through the courtesy of the Director of the Greenland Colonies. Data of values not available.
[b] Data not available.

HUNGARY.

Mineral production of Hungary, 1919 and 1920.[a]

Mineral.	1919		1920	
	Tons.	Value (kronen).	Tons.	Value (kronen).
Antimony: Ore[b]	759	(c)	1,054	(c)
Crude	19	(c)	10	(c)
Regulus			216	(c)
Bauxite	(d)	(d)	(d)	(d)
Cement, Portland	(e)	(e)	(e)	(e)
Clay, fire	(d)	(d)	(d)	(d)
Coal: Bituminous	142,490	85,494,000	167,920	167,920,000
Lignite	3,759,230	1,879,715,000	4,795,140	4,316,641,500
Iron: Ore	112,525	11,453,070	101,665	20,333,000
Pig iron	(f)	(f)	(f)	(f)
Kaolin	(d)	(d)	(d)	(d)
Manganese ore[g]	100	16,000		
Mineral waters	(d)	(d)	(d)	(d)
Peat	(d)	(d)	(d)	(d)
Slate	(d)	(d)	(d)	(d)

[a] Data furnished by the Bureau of Mines, Ministry of Finance, Budapest, and the American Commission at Budapest.
[b] Average metal content 11 per cent.
[c] Value unknown, as there was no trade in the commodity.
[d] Deposits reported, but data of production not available.
[e] Data of production not available.
[f] Plants closed for want of coke.
[g] Average metal content 33 per cent.

ICELAND.[1]

Lignite, Iceland spar, and iron ore are the principal mineral products of Iceland. In 1919 the production of lignite was 390 metric tons, but in 1920 the mine was idle. The spar mine was leased to a French company from July 1, 1910, to June 30, 1920, and has been idle since 1914. In 1920 it was taken over by the Government of Iceland and preparations are in progress for reopening it. Thirty tons of iron ore was mined in 1918, samples of which showed satisfactory results when smelted in Sweden. The deposit was not worked in 1919 or 1920.

INDO-CHINA.

Mineral production of Indo-China in 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (francs).	Quantity.	Value (francs).
Coal.....tons..	665,149	23,290,000	[b] 700,267	(c)
Gems.....carats..	(c)	(c)	3,413	(c)
Graphite.....tons..	7,500	(c)		
Iron ore.....do....	5,100	68,000		
Phosphate rock.....do....	7,050	530,000	13,200	(c)
Tin and tungsten ore.....do....	429	1,560,000	438	(c)
Zinc ore.....do....	15,934	4,750,000	7,198	(c)

[a] Data for 1919 compiled from Statistique de l'industrie minérale et des appareils à vapeur en France et en Algérie pour l'année 1919; those for 1920 from the Mining Journal, London.
[b] Includes 7,186 tons of lignite.
[c] Data not available.

[1] Data furnished by the Director of Mining Operations in Iceland.

ITALY.

Mineral production of Italy,[a] 1919 and 1920.[b]

Mineral.	1919		1920	
	Quantity.	Value (lire).	Quantity.	Value (lire).
Abrasives: Diatomaceous earth...tons..	15	3,000	25	5,000
Grindstones, honestones....do....	1,340	774,100	1,410	2,124,100
Millstones....do....	1,858	217,775	1,857	221,750
Pumice—Crude....do....	13,210	441,340	25,200	1,737,274
Ground....do....	8,450	1,014,000	9,325	1,119,000
Aluminum....do....	1,673	9,603,750	1,238	15,532,200
Alunite....do....	3,507	152,280	3,445	165,119
Ammonium sulphate....do....	2,739	3,370,700	1,047	2,198,700
Antimony: Ore [c]....do....	25	10,000	882	189,057
Ground ore....do....			80	48,000
Sulphide, liquated....do....	10	20,000	80	160,000
Arsenic ore [d]....do....	3	300		
Asbestos....do....	98	103,600	165	168,250
Asphalt and bituminous rock....do....	78,000	3,044,370	106,642	6,046,485
Barytes: Crude....do....	15,920	630,100	15,380	1,068,600
Ground....do....	19,390	1,442,600	17,850	2,347,500
Bauxite....do....	2,972	128,440	13,139	946,916
Bitumen, crude....do....	635	635,000	984	984,000
Boric acid....do....	2,063	2,681,900	1,719	2,320,650
Clay, for brick and terra cotta....do....	3,559,140	10,477,860	4,745,140	16,981,200
Coal: Anthracite....do....	22,281	6,269,400	28,402	8,516,600
Bituminous....do....	88,870	(e)	123,460	51,270,910
Lignite....do....	1,129,197	(e)	1,571,735	182,992,532
Coke, metallurgical....do....	302,737	115,786,030	95,727	69,905,792
Copper: Ore....do....	16,679	854,659	(f) 16,209	3,288,496
Blister copper....do....	1,243	7,458,000	635	4,572,000
Cement copper....do....	[g] 168	672,000		
Feldspar: Crude....do....	1,100	48,000	2,600	209,000
Ground....do....	320	62,400	1,650	311,500
Fluorspar....do....	900	27,000	810	36,450
Graphite: Crude....do....	7,626	783,330	5,398	823,430
Ground....do....	4,304	745,290	5,703	1,727,790
Gypsum: Alabaster....do....	2,500	750,000	8,114	3,326,740
For calcination....do....	324,400	1,639,300	349,250	2,784,800
Other....do....	10,460	157,000	10,960	206,080
Ichthyol....do....	7	140,000	9	153,000
Ichthyolic shale....do....	1,000	(e)	800	124,000
Iron: Ore....do....	613,025	22,810,216	389,876	17,434,330
Pig iron....do....	239,710	143,512,775	88,072	90,663,802
Kaolin and kaolinic earth....do....	19,072	1,816,940	19,323	1,794,599
Lead: Ore....do....	33,212	(e)	40,064	40,681,130
Metal (smelter output)....do....	16,530	22,800,486	15,947	35,609,171
Litharge....do....			4	100,000
Magnesite (giobertite)....do....	35,930	2,335,450	33,850	2,306,250
Magnesium sulphate....do....	508	55,880	1,200	300,000
Manganese ore [h]....do....	30,841	2,727,596	36,158	3,880,540
Manganiferous iron ore [i]....do....	68	2,380	90	9,000
Mineral paints: Ocher, umber, etc....do....	7,836	447,360	11,838	778,838
Red lead....do....			18	440,000
Mineral waters....do....	63,000	504,000	55,545	1,110,900
Molybdenum ore [j]....kilograms..	1,500	15,000	1,300	39,000
Natural gas....cubic meters..	8,758,000	1,798,220	7,618,419	7,618,419
Oil distilled from coal, peat, and shale...tons..	917	740,400	1,506	2,258,000
Oil shale....do....	10,563	689,020	16,325	1,526,955
Peat....do....	100,901	8,617,360	147,607	13,285,640
Petroleum....do....	4,851	5,086,450	4,937	7,099,450
Puzzolan, broken lava, and scoria....do....	482,600	2,563,560	501,000	4,047,000
Pyrites: Cupreous iron....do....	15,388	961,728	19,267	1,445,025
Iron....do....	357,086	23,853,972	302,322	26,493,030
Quartz: Crude....do....	81,404	1,605,267	63,480	1,825,940
Ground....do....	1,440	226,100	2,000	400,000
Quicksilver, metallic....do....	845	(e)	1,401	43,776,000
Refractory materials....do....	39,878	711,692	54,627	1,173,100
Salt: Rock....do....	41,313	1,964,319	46,989	5,068,300
From springs....do....	21,376	10,078,290	22,026	10,441,125
From sea water....do....	473,059	6,765,737	658,103	17,888,390

[a] Including the new provinces (Terre Redente).
[b] Rivista del servizio minerario, Ministero di Agricoltura, Rome.
[c] Average metal content: 1919, 50 per cent; 1920, 26.50 per cent.
[d] Average arsenic content, 1919, 40 per cent.
[e] Data not available.
[f] Includes 1,759 tons of argentiferous copper ore.
[g] Exclusive of 1,332 tons made into blister copper.
[h] Average manganese content: 1919, 35.40 per cent; 1920, 26.41 per cent.
[i] Average manganese content: 1919, 8 per cent; 1920, 12.50 per cent.
[j] Average metal content: 1919, 30 per cent; 1920, 47 per cent.

Mineral production of Italy, 1919 and 1920—Continued.

Mineral.	1919		1920	
	Quantity.	Value (lire).	Quantity.	Value (lire).
Sand, gravel, and flint.....tons..	1,506,716	8,749,505	1,522,458	14,032,720
Silver.....kilograms..	8,240	3,402,620	9,252	5,783,292
Silver ore.....tons..	15	16,600	665	488,110
Slate.....do....	7,550	590,125	15,490	1,730,250
Soapstone.....do....	15	3,900	20	5,500
Sodium, metallic.....kilograms..	850	8,500	(e)	(e)
Stone: Building and ornamental stone—				
Marble—White.....tons..	242,029	43,197,365	312,701	90,669,100
Colored.....do....	23,745	5,259,025	39,720	12,099,200
Other.....do....	4,810,934	33,049,355	5,666,073	60,223,237
Leucite for industrial uses.....do....	3,468	348,153	8,200	1,217,700
Limestone for industrial uses.....do....	2,082,713	18,869,660	2,690,855	36,661,955
Lithographic stone.....do....	15	10,425	300	225,000
Other stone.....do....	457,103	3,604,400	582,098	6,775,625
Sulphur: Crude.....do....	226,126	100,310,590	263,603	166,201,520
Ground rock.....do....	29,190	4,185,846	32,496	6,499,200
Talc: Crude.....do....	17,550	2,281,500	21,475	4,050,250
Ground.....do....	17,184	3,522,720	20,570	7,096,650
Tar.....do....	8,368	1,255,200	3,550	1,733,750
Zinc: Ore.....do....	85,778	(e)	95,985	46,720,102
Dust.....do....	6	18,000	.....	.....
Ingots.....do....	1,282	2,931,104	1,177	3,650,200
Oxide.....do....	862	1,858,983	1,302	4,154,326
Zinc-lead ores.....do....	3,915	266,775	570	37,200

e Data not available.

Mineral production of the new provinces of Italy (Terre Redente), 1919 and 1920, in tons.[a]

Province and mineral.	1919	1920
VENEZIA TRIDENTINA.		
Coal: Bituminous	70	375
Lignite	5,900	3,100
Copper ore	26	.....
Ichthyolic shale	800	600
Iron ore	(b)	350
Lead ore	.....	264
Pyrites, iron	100	1,550
Zinc ore	4,860	7,201
VENEZIA GIULIA.		
Bauxite	.....	6,500
Coal, bituminous	87,400	107,150
Lead ore	1,082	1,965
Quicksilver, metallic	297	526
Zinc ore	15,289	19,450

a Rivista del servizio minerario, Ministero di Agricoltura, Rome, and official data furnished by the American consul general, Rome.
b Data not available.

JAPAN.

Mineral production of Japan, 1919 and 1920.[a]

State and mineral.	1919		1920	
	Quantity.	Value (yen).	Quantity.	Value (yen).
JAPAN PROPER.				
Antimony: Sulphide.....kilograms..	1,614	287	.....	.....
Arsenic: Ore.....tons..	968	13,991	2,171	(b)
White arsenic.....do....	835	192,763	932	162,407
Asphalt.....do....	6,674	349,843	6,930	(b)
Bismuth: Ore.....kilograms..	450	1,440	.....	.....
Metal.....do....	349	4,731	224	2,984

a Mining Industry of Japan, Financial and Economic Annual of Japan, Tokyo, data furnished by the American embassy, Tokyo, the American consul general, Keijo (Seoul), and the American consul, Taihoku.
b Data not available.

Mineral production of Japan, 1919 and 1920—Continued.

State and mineral.	1919		1920	
	Quantity.	Value (yen).	Quantity.	Value (yen).
JAPAN PROPER—continued.				
Chromite ..... tons	6,012	294,594	3,968	170,508
Coal: Bituminous ..... do	31,271,093	442,540,941	29,345,348	418,073,754
Lignite ..... do	190,293	1,298,195	178,305	1,249,655
Coke, natural ..... do	84,275	869,404	67,106	657,632
Copper: Ore ..... do	578,014	(b)	373,882	(b)
Metal ..... kilograms	78,443,317	67,581,475	67,792,200	47,577,401
Gold ..... grams	7,270,166	9,681,494	7,680,334	(b)
Gold and silver ores ..... tons	93,535	(b)	99,176	(b)
Graphite ..... do	1,950	106,167	1,133	80,758
Iron: Ore ..... do	204,846	(b)	203,559	(b)
Pig iron ..... do	209,005	38,810,554	168,729	19,882,076
Lead: Ore [c] ..... do	1,469	(b)	787	(b)
Metal ..... do	5,771	1,592,483	4,167	1,384,172
Manganese ore ..... do	22,877	690,096	5,471	157,692
Molybdenum ore ..... do			86	(b)
Natural gas ..... M cubic meters	29,697	2,855,509	38,238	(b)
Petroleum ..... hectoliters	3,542,087	42,562,023	3,517,624	(b)
Phosphate rock ..... tons	122,868	4,775,630	97,340	3,880,619
Platinum dust ..... grams	4,830	47,629	8,014	58,118
Pyrites: Iron ..... tons	126,999	1,828,731	108,862	(b)
Cupreous iron ..... do	162,158	(b)	158,227	(b)
Quicksilver, metallic ..... kilograms	630	4,199	2,684	8,963
Salt ..... tons	[d] 403,205	[d] 14,826,028	(b)	(b)
Silver ..... grams	160,583,100	11,131,055	152,163,750	9,865,435
Sulphur: Ore ..... tons	16,766	169,001	26,140	284,585
Crude sulphur ..... do	50,631	2,256,324	39,600	1,876,955
Tin: Ore ..... do	7	3,782		
Metal ..... do	101	235,554	205	(b)
Tungsten ore ..... do	530	621,954	157	(b)
Zinc: Ore ..... do	495,705	(b)	702,985	(b)
Metal ..... do	19,816	8,145,244	15,745	(b)
CHOSEN (KOREA).				
Abrasives: Diatomaceous earth ..... tons	30,054	44,771	28,803	(b)
Asbestos ..... do	132	5,980	(b)	(b)
Coal ..... do	223,078	2,124,831	(b)	(b)
Copper: Ore ..... do	13	700	(b)	(b)
Metal ..... kilograms	2,287,954	1,906,628	858,192	1,339,203
Gold ..... grams	3,171,821	4,075,049	3,234,762	(b)
Gold and silver ores and concentrates ..... tons	120,816	3,141,176	28,374	1,527,481
Graphite ..... do	9,240	258,757	11,205	971,196
Iron: Ore ..... do	423,267	3,094,573	(b)	(b)
Pig iron ..... do	79,995	10,168,605	38,555	6,045,785
Kaolin ..... do	1,010	10,117	(b)	(b)
Lead: Ore ..... do	360	37,208	753	(b)
Metal (work lead) ..... do	653	243,592	584	(b)
Mica ..... do	13	2,371	(b)	(b)
Molybdenite ..... kilograms	131	35	1,814	(b)
Quicksilver, metallic ..... do	731	4,514	(b)	(b)
Silver ..... grams	141,559	10,061	(b)	(b)
Sulphide ores [e] ..... tons	2,851	194,781	(b)	(b)
Tungsten ore ..... do	59	54,625	(b)	3,525
Zinc ore ..... do	514	36,236	3,481	56,467
KARAFUTO.				
Coal ..... tons	137,600	(b)	(b)	(b)
TAIWAN.				
Coal ..... tons	1,104,352	8,825,002	1,158,000	(b)
Copper: Ore ..... do	9,527	412,847	8,000	(b)
Metal ..... kilograms	883,855	713,221	691,000	(b)
Gold ..... grams	695,895	910,311	568,000	(b)
Iron sand ..... kilograms	5,595	665		
Petroleum ..... hectoliters	14,825	178,130	15,000	(b)
Silver ..... grams	627,806	41,459	558,000	(b)
Sulphur, crude ..... tons	1,453	85,791	800	(b)

[b] Data not available.
[c] Includes some silver-lead ore.
[d] Data for fiscal year ended Mar. 31, 1919.
[e] Ores containing gold, silver, copper, lead, and zinc.

LUXEMBURG.

Mineral production of the Grand Duchy of Luxemburg, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value(francs).	Quantity.	Value(francs).
Cement.....tons..	(b)	(b)	50,000	(b)
Iron: Ore.....do....	3,112,472	25,366,646	3,704,390	37,997,000
Pig iron.....do....	617,422	157,870,782	692,935	383,109,601
Slate: Roofing slates.....number..	9,630,000	(b)	10,079,000	(b)
Sinkstones.....do....	185	(b)	163	(b)
Slabs.....square meters..	1,958	(b)	2,450	(b)
Quarry products (stone, sand, and gravel) .....cubic meters..	800,000	(b)	190,000	(b)

[a] Data furnished by the American consul general, Rotterdam, Netherlands..
[b] Data not available.

MADAGASCAR.

Mineral production of Madagascar, 1919 and 1920.[a]

[Exports.]

Mineral.	1919	1920	Mineral.	1919	1920
Abrasives: Corundum .....kilograms..	812,181	521,461	Molybdenum.....grams..	.....	951
Agate.....do....	.....	30,000	Nickel ore.....kilograms..	.....	100
Amazonite.....grams..	.....	3,200	Pyrites, iron.....do....	65,000	.....
Asbestos.....do....	.....	800	Quartz, colored or opaque .....kilograms..	41	18,227
Copper ore.....kilograms..	.....	237	Rare earths.....do....	.....	2,501
Graphite.....do....	4,983,098	14,424,994	Rock crystal: Clear...do....	2,039	2,596
Iron ore[b].....do....	20,293	34,834	Opaque.do....	1,559	41,862
Gems[b].....grams..	4,438,423	3,981,993	Uranium ore.....do....	10,146	5,149
Gold[b].....do....	561,063	518,771	Zircon.....do....	1,100	3,879
Mica.....kilograms..	18,694	49,521			

[a] Rapport sur le fonctionnement du Service des Mines, Bulletin économique de Madagascar, Tananarive. The values of the minerals are not stated.
[b] Figures represent production, not exports.

MEXICO.

Mineral production of Mexico, 1919 and 1920.[a]

Mineral.	1919	1920	Mineral.	1919	1920
Antimony[b] .....kilograms..	470,738	622,572	Molybdenum .....kilograms..	1,767	4,230
Arsenic, white.do...	2,246,373	[c] 2,183,000	Petroleum[f]..tons..	12,964,000	24,410,000
Coal[d].....tons..	693,866	(e)	Quicksilver[b] .....kilograms..	118,940	75,748
Copper[b]..kilograms..	52,172,234	49,192,401	Silver, fine..grams..	2,049,897,884	2,068,938,228
Gold, fine....grams..	23,586,764	22,864,316	Tin[b]....kilograms..	1,588	.....
Graphite.kilograms..	4,023,015	3,222,941	Tungsten[b]....do....	21,970	40,020
Lead[b].....do...	71,375,968	82,517,598	Zinc[b].....do....	11,559,685	15,650,590
Manganese ore.do...	2,794,227	1,137,400			

[a] Statement issued Jan. 20, 1922, by the Departmento de Impuestos Especiales, Secretaria de Hacienda y Crédito Público, Mexico, except where otherwise noted.
[b] Estimated metal content of ores.
[c] Heikes, V. C., U. S. Geol. Survey Mineral Resources, 1920, pt. 1, p. 60.
[d] Bol. minero, Departamento de Minas, Mexico.
[e] Data not available.
[f] Bol. del petróleo, Departamento de Petróleo, Mexico.

NETHERLANDS.

Mineral production of the Netherlands, 1919 and 1920. [a]

Mineral.	1919		1920	
	Quantity.	Value (florins).	Quantity.	Value (florins).
Briquets (fuel)....tons..	584,420	15,682,065	633,930	19,535,096
Coal: Bituminous....do....	3,540,064	72,563,011	4,115,629	106,859,589
Lignite....do....	1,881,962	18,868,628	1,395,851	11,149,656
Coke....do....	25,940	913,866	138,987	5,764,007
Limestone: Building stone....cubic meters..	4,125	(b)	6,900	(b)
Dust and rubble....tons..	14,481	(b)	25,050	(b)
Peat [c]				
Salt, rock....tons..	5,244	(b)	24,857	(b)
Zinc (spelter) [d]....do....			2,031	(b)

[a] Jaarverslag van den Hoofdingenieur der Mijnen, The Hague.
[b] Value not stated.
[c] The latest data available for peat production relate to the year 1915. In that year the more important peat bogs produced 1,300,788,000 blocks of peat for fuel and 464,278,000 blocks for other purposes (Jaarcijfers voor het Koninkrijk der Nederlanden, 1918).
[d] Data furnished by the American consul general, Rotterdam, through the courtesy of the Société anonyme des zincs de la Campine.

NETHERLANDS EAST INDIES.

Mineral production of the Netherlands East Indies, 1919 and 1920. [a]

Mineral.	1919	1920	Mineral.	1919	1920
Coal: Lignite....tons..		279	Manganese ore....tons..	2,915	4,179
Stone coal....do....	949,379	1,095,439	Natural gas....do....	146,213	188,736
Diamonds....carats [b]..	966	410	Petroleum....do....	2,159,867	2,365,320
Gold, fine....grams..	2,881,062	2,827,666	Silver, fine....grams..	31,316,481	31,973,259
Iodide of copper....tons..		16	Tin, metal....tons..	20,700	21,929

[a] Data furnished by the Chief of the Mining Bureau, Weltevreden, Java. Values not stated.
[b] One metric carat=0.2 gram.

Tin produced in the Netherlands East Indies, 1919 and 1920, by districts, in tons.

District.	1919	1920	District.	1919	1920
Banka	12,387	13,643	Bangkinang (Sumatra, west coast)	1	
Billiton	7,584	7,668			
Singkep (Island)	326	239			
Singkep (sea tin concessions)	402	379			
				20,700	21,929

NETHERLANDS WEST INDIES.

Phosphate rock and marine salt were the only minerals produced in the Netherlands West Indies in 1919 and 1920. The islands of Aruba and Curaçao formerly produced some gold, but no production of the precious metal has been reported in recent years. The phosphate beds of Aruba, also, have not been worked for some years. The mineral output of the colony during 1919 and 1920 was as follows:

Mineral production of the Netherlands West Indies, 1919 and 1920.[a]

[Exports.]

Island and mineral.	1919		1920	
	Tons.	Value (florins).	Tons.	Value (florins).
Bonaire: Salt, marine	2,384	16,941	13,974	71,060
Curaçao: Phosphate rock	10,058	176,016	61,440	1,844,283
Salt, marine			4,846	50,997
St. Martin: Salt, marine	4,546	36,554	6,633	52,931

[a] Data furnished by the governor, Willemstad, Curaçao. Figures represent exports, as statistics of production are not available.

NEW CALEDONIA.

Mineral production of New Caledonia in 1919.[a]

Mineral.	Tons.	Value (francs).	Mineral.	Tons.	Value (francs).
Chromite [b]	46,000	4,295,000	Manganese ore	2,309	1,154
Cobalt ores	31	2,170	Nickel ore	80,670	5,082,000
Gypsum	4,406	2,203	Phosphate rock	5,729	200,000

[a] Statistique de l'industrie minérale et des appareils á vapeur en France et en Algérie pour l'année 1919. Figures represent production. Similar data for 1920 are not available.

[b] The exports of chromite in 1919 and 1920 are officially reported to have been 23,548 tons and 91,534 tons, respectively.

NEWFOUNDLAND.

The mineral resources of Newfoundland include antimony, asbestos, chromite, coal, copper, gold, granite, iron, lead, limestone, manganese, molybdenite, oil shale, petroleum, pyrites, silver, slate, and talc, but the only data of production available relate to iron ore and limestone.

Iron ore and limestone produced in Newfoundland in 1919 and 1920.[a]

Mineral.	1919		1920	
	Tons.	Value.	Tons.	Value.
Iron ore	703,050	$577,787	266,972	$394,131
Limestone	101,739	50,066	130,964	114,042

[a] Data furnished by the Deputy Minister, Department of Agriculture and Mines, St. Johns.

NEW ZEALAND.

Mineral production of New Zealand, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Asbestos.....kilograms..	.....	.....	1,778	105
Coal: Bituminous and semibituminous...tons..	976,533	2,693,163	1,873,296	(b)
Lignite.....do....	900,973			
Coke c.....do....	46	113	20	63
Gold, bullion.....grams..	9,959,646	1,334,405	14,763,267	528,137
Kauri gum c.....tons..	4,194	238,812	6,951	556,756
Lime c.....kilograms..	19,914	84	15,342	68
Manganese ore c.....tons..	.....	.....	2	10
Phosphate rock.....do....	4,064	(b)	(b)	(b)
Pumice: Sand c.....do....	1,054	2,840	106	327
Stone c.....do....	.....	.....	2,783	7,172
Quicksilver.....kilograms..	8,738	4,619	1,667	1,378
Silver.....grams..	14,107,513	103,037	11,489,626	87,665
Stone: Building stone c.....tons..	34	28	38	32
Limestone for agriculture, cement, etc. .....tons..	249,127	(b)	(b)	(b)
Other c.....do....	.....	1,000	.....	1,146
Tungsten ores: Scheelite c.....do....	133	29,489	10	1,378

[a] Data furnished by the Minister of Mines, Department of Mines, New Zealand.
[b] Data not yet available.
[c] Exports.

NIGERIA.

Mineral production of Nigeria, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Antimony ore.....kilograms..	704	31	744	75
Coal.....tons..	140,057	60,000	183,013	(b)
Gold, dust.....grams..	9,922	(b)	13,748	2,293
Iron ore c.....	(c)	(c)	(c)	(c)
Salt c.....	(c)	(c)	(c)	(c)
Tin concentrates.....tons..	8,300	1,391,801	[d] 8,040	1,785,724

[a] Annual Report on the Mines Department, Northern Provinces, and data furnished by the American consul, Dakar, Senegal.
[b] Data not available.
[c] Small output from native workings, for which no figures are available. Quantity produced inadequate for requirements.
[d] Exports.

NONFEDERATED MALAY STATES.

Mineral production of the Nonfederated Malay States, 1919 and 1920.

[Exports.]

State and mineral.	1919		1920	
	Quantity.	Value (Straits dollars).	Quantity.	Value (Straits dollars).
Johore: [a] Tin concentrates [b] ..... tons..	1,876	2,638,600	1,611	3,996,000
Tungsten ore: Wolframite..kilograms..	30	386	.....	.....
Kedah: [c] Tin concentrates [b] ..... tons..	627	952,534	482	1,009,538
Tungsten ore: Wolframite [d] ... do....	15	(e)	11	(e)
Kelantan: [f] Tin concentrates ..... do....	2	2,124	2	5,898
Perlis: [g] Tin concentrates [h] ..... do....	(e)	(e)	263	454,450
Trengganu: [i] Tin concentrates..... do....	630	828,966	491	813,683
Tungsten ore: Scheelite... do....	562	611,670	155	102,582
Total: Tin concentrates..... tons..	3,135	4,422,224	2,849	6,279,569
Tungsten ores: Wolframite..do....	15	(e)	11	(e)
Scheelite....do....	562	611,670	155	102,582

[a] Data furnished by the warden of mines, Johore.
[b] Average metal content 72 per cent.
[c] Data furnished by the superintendent of mines, Kedah.
[d] Average content approximately 68 per cent WO_3.
[e] Data not available.
[f] Data furnished by the British adviser to the Government of Kelantan.
[g] Data furnished by the British adviser to the Government of Perlis.
[h] Average metal content 70 per cent.
[i] Data furnished by the British adviser to the Government of Trengganu.

NORWAY.

Mineral production of Norway, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (kroner).	Quantity.	Value (kroner).
Chromite..... tons..	460	50,000	.....	.....
Copper: Ore..... do....	21,974	460,000	6,809	310,000
Metal..... kilograms..	437,200	936,000	555,880	1,175,000
Feldspar..... tons..	5,166	364,000	6,397	502,000
Fluorspar..... do....	560	44,000	.....	.....
Graphite..... do....	.....	.....	10	2,000
Iron: Ore..... do....	89,765	2,681,000	79,208	2,110,000
Pig iron..... do....	3,555	2,460,000	5,771	3,086,000
Manganese ore..... do....	22	4,000	.....	.....
Molybdenum ore..... do....	83	1,455,000	.....	.....
Nickel: Ore..... do....	10,050	250,000	12,482	299,000
Metal..... kilograms..	222,206	1,110,000	421,500	1,862,000
Phosphate rock (apatite)..... tons..	1,168	158,000	.....	.....
Pyrites: Arsenical..... do....	20	3,000	.....	.....
Cupreous iron..... do....	309,011	23,701,000	333,011	15,376,000
Rutile..... do....	20	17,000	40	40,000
Silver: Ore..... do....	8,947	1,877,000	8,018	1,819,000
Bullion..... kilograms..	10,620	1,794,000	10,052	1,772,000
Talc..... tons..	2,988	49,000	.....	.....
Titaniferous iron ore..... do....	4,249	285,000	3,378	330,000
Zinc-lead ore..... do....	337	12,000	148	4,600

[a] Norges Bergverksdrift, Kristiania.

PAPUA.

Mineral production of Papua, 1919 and 1920.[a]

Mineral.	1919[b]		1920[b]	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Copper ore.....tons..	1,413	(c)	7,840	31,142
Gold, crude.....grams..	370,722	26,596	365,497	21,757
Iron ore.....tons..	.....	.....	10	107
Osmiridium.....grams..	.....	.....	3,110	3,300
Silver.....do....	24,199	170	(c)	(c)

[a] Papua: Ann. Rept. [b] Year ending June 30. [c] Data not available.

PERU.

Mineral production of Peru, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (libras).	Quantity.	Value (libras).
Antimony ore[b].....tons..	60	272	[c] 13	109
Asphaltite.....do....	14,033	(d)	17,162	(d)
Bismuth, metal[b].....kilograms..	.....	.....	7,820	6,882
Borax, crude[b].....tons..	519	7,785	261	4,698
Coal: Anthracite.....do....	11,100	(d)	9,308	(d)
Bituminous.....do....	319,127	(d)	351,767	(d)
Copper, metal.....do....	39,230	2,879,983	32,982	2,358,243
Gold, fine.....kilograms..	2,029	267,303	1,952	265,972
Lead, metal.....tons..	1,066	16,227	562	10,959
Mineral waters.....liters..	263,667	7,910	260,667	11,730
Molybdenite, pure.....kilograms..	4,027	1,194	2,054	550
Petroleum.....tons..	348,649	2,363,544	373,280	2,484,570
Salt, crude.....do....	27,724	24,843	27,172	21,655
Silver, fine.....kilograms..	305,497	2,071,257	286,043	1,853,221
Tungsten concentrates.....tons..	[e] 129	14,120	[e] 69	5,316
Vanadium ore[f].....do....	2,947	388,470	9,700	897,840
Zinc ore, argentiferous[b].....do....	.....	.....	49	94

[a] Cuerpo Ing. Minas del Perú Bol. 100, Lima, and official data supplied through the courtesy of the Cuerpo de Ingenieros de Minas del Perú.
[b] Exports.
[c] Average metal content, 65 per cent.
[d] Data not available.
[e] Average content WO_3: 1919, 64.7 per cent; 1920, 66.3 per cent.
[f] Average content V_2O_5: 1919, 30.41 per cent; 1920, 20.43 per cent.

POLAND.

Mineral production of Poland,[a] 1919 and 1920, in tons.[b]

Mineral.	1919	1920	Mineral.	1919	1920
Cement	[c] 150,000	236,889	Natural gas ..... cubic meters	[c] 470,000,000	[c] 420,000,000
Chalk	[c] 150,000	[c] 200,000	Ozokerite	299	368
Coal: Bituminous	6,083,687	6,411,668	Petroleum	831,704	765,004
Lignite	178,949	248,477	Potash (kainite and sylvinite), crude	2,500	10,293
Copper ore	4	10	Salt	169,203	245,604
Iron: Ore	93,342	120,000	Sulphur ores	118	264
Pig iron	15,214	42,221	Zinc: Ore	67,645	64,354
Gypsum	[d]	[d]	Metal	4,652	5,361
Lead: Ore	298	899			
Metal (work lead)	636	[d]			

[a] As eastern Galicia is under Polish jurisdiction pending the final disposition of the territory by a plebiscite, the mineral output of the district is here included with Poland for the sake of convenience.
[b] Data furnished by the Polish Government through the American legation, Warsaw.
[c] Approximate figures.
[d] Data not available.

Petroleum produced in Poland (including eastern Galicia), 1919 and 1920, by districts, in tons.[a]

District.	1919	1920
Drohobycz	758,836	690,764
Jaslo	51,724	49,317
Stanislaw	21,144	24,923
	831,704	765,004

[a] Data furnished by the Polish Government through the American legation, Warsaw.

PORTUGAL.

Mineral production of Portugal, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (escudos).	Quantity.	Value (escudos).
Arsenic: Ore ..... tons	62	4,989	62	12,017
White arsenic ..... do	536	83,020	653	143,581
Coal: Anthracite ..... do	146,341	956,336	169,165	2,261,949
Lignite ..... do				
Copper: Ore ..... do	390	56,646	2,161	97,259
Precipitate ..... do	2,298	915,167	1,437	1,419,413
Iron ore ..... do	8,712	44,431	12,845	56,546
Lead ore ..... do	118	7,265	341	41,83[illegible]
Manganese ore ..... do	193	5,800	925	23,48[illegible]
Mineral waters [b] ..... kilograms	118,602	36,088	[c]	[c]
Phosphate rock ..... tons	300	9,000	1,775	79,[illegible]
Pyrites, cupreous ..... do	52,404	262,806	245,811	3,182,[illegible]t
Salt [b] ..... do	45,026	249,232	[c]	[c] [illegible]d:
Silver, bullion ..... kilograms			38	[illegible]tallic
Tin: Concentrates ..... tons	279	276,356	174	[illegible]rates.
Metal ..... do	13	26,537	7	
Tungsten ore, wolframite ..... do	614	540,883	218	
Uranium ore ..... do	1,380	78,350	437	

[a] Information furnished by the American consul general, Lisbon. Data compiled from official
[b] Exports.
[c] Data not available.

RHODESIA.

Mineral production of Northern Rhodesia, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Bismuth ore.....tons..			1	910
Copper, metal.....do....	185	10,210	132	7,602
Gold, fine.....grams..	6,967	938	17,698	[b] 2,998
Lead (smelter output).....tons..	12,859	226,778	14,836	335,000
Mica.....do....			1	412
Silver, fine.....grams..	267,210	861	142,547	[b] 707

[a] Rhodesia Chamber of Mines, Salisbury, Ann. Rept.
[b] The increase in values for gold and silver is due to premiums brought to account in 1920.

Mineral production of Southern Rhodesia, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Antimony ore.....tons..			10	219
Arsenic ore.....do....	220	10,486	396	16,510
Asbestos.....do....	8,889	425,240	17,076	459,572
Chrome ore.....do....	32,007	142,541	54,675	245,378
Coal: Mined.....do....	462,698	[b]	524,796	[b]
Sold.....do....	264,624	135,023	302,995	186,435
Used for coke.....do....	137,320	52,985	142,515	63,923
Used in limekilns.....do....	2,928	1,130	4,173	1,862
Coke [c].....do....	94,109	[b]	94,526	[b]
Copper, metal.....do....	2,732	207,470	2,820	333,111
Diamonds.....grams..	77	3,083	49	1,918
Gold, fine.....do....	18,451,269	2,499,498	17,184,611	[d] 3,056,549
Ironstone.....tons..	2,268	312		
Mica.....do....	5	1,345	88	25,153
Silver, fine.....grams..	5,349,799	34,099	4,944,894	[d] 58,178
Tin concentrates.....tons..	4	1,060	4	661
Tungsten concentrates.....do....	18	5,103	15	1,519

[a] Secretary for Mines, Southern Rhodesia, Salisbury, Rept.
[b] Value not stated.
[c] Rhodesia Chamber of Mines, Ann. Rept.
[d] The increase in values for gold and silver is due to premiums brought to account in 1920.

RUMANIA.

Mineral production of Rumania, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (lei).	Quantity.	Value (lei).
halt.....kilograms..	750,000	112,500	[b]	[b]
nt.....tons..	83,600	83,600,000	[b]	[b]
nthracite.....do....	11,369	3,148,441	15,919	8,714,660
tuminous.....do.... }	1,529,229	262,624,204	1,489,265	343,378,300
ite.....do.... }				
.....kilograms..	740	18,503,100	705	28,144,440
.....tons..	43,945	4,069,434	43,202	11,431,610
ore.....do....	2,755	1,178,219	247	604,046
.....kilograms..	2,000	576,000	[b]	[b]
.....cubic meters..	309,385,000	12,375,400	324,314,489	16,215,724
.....tons..	855,561	143,552,675	1,092,140	698,273,568
.....do....	45,000	22,500,000	50,000	25,000,000
.....do....	94,955	26,420,082	76,741	27,237,508

[a] by the Ministry of Industry and Commerce, Rumania.
[b] ble.
role roumain, vol. 21, No. 4, 1922, gives output as follows: 1919, 920,437 tons; 1920,

Petroleum produced in Rumania, 1919 and 1920, by districts, in tons.[a]

District.	1919	1920	District.	1919	1920
Bacau	42,563	46,761	Maramures	70	72
Buzau (Buzeu)	41,475	66,197	Prahova	656,478	843,609
Dambovitza	114,975	135,501		855,561	1,092,140

[a] Data furnished by the Ministry of Industry and Commerce, Rumania.

RUSSIA.

No comprehensive statistics of the mineral production of either European or Asiatic Russia during the last five years are available.

The mineral resources of the country include alum, antimony, arsenic, asbestos, asphalt, barytes, bauxite, bismuth, borax, chromite, clay, coal, cobalt, copper, diatomaceous earth, fluorspar, fuller's earth, gems, gold, graphite, gypsum, iron, lead, lithium minerals, magnesite, manganese, mica, mineral waters, molybdenum, natural gas, oil shale, ozokerite, peat, petroleum, phosphate rock, platinum, potash, pumice, iron pyrites, quicksilver, salt, silver, silver-lead ore, soapstone, sodium sulphate, strontium, sulphur, talc, tin, tungsten, and zinc.

The principal mineral workings in Russia are those of coal, gold, iron, manganese, petroleum, platinum, and salt. The best information available gives the production of coal in 1919 and 1920 as 8,299,000 and 7,699,000 tons, respectively, and that of petroleum as 3,477,000 and 3,471,000 tons, respectively.

SIAM.

Mineral production of Siam, 1919 and 1920.[a]

[Exports.]

Mineral.	1919		1920	
	Quantity.	Value (ticals).	Quantity.	Value (ticals).
Gems: Rubies		161,330		97,515
Sapphires		2,481,710		661,565
Gold leaf.....pieces..	95,500	5,050	5,000	385
Salt.....tons..	63,430	910,662	50,738	841,899
Tin, metallic [b].....do....	8,679	(c)	6,301	14,928,744
Tungsten ore: Wolframite.....do....	221	(c)	117	132,957

[a] Data furnished by the Royal Department of Mines, Siam. Figures of export practically represent total production except for salt, of which there is a considerable domestic consumption. Period covered: 1919, Apr. 1, 1919–Mar. 31, 1920; 1920, Apr. 1, 1920–Mar. 31, 1921.

[b] Figures represent metallic content of concentrates, taken arbitrarily at 70 per cent. The actual metallic content probably averages about 71–72 per cent. Tin exports are almost entirely in the form of concentrates.

[c] Data not available.

SPAIN.

Mineral production of Spain, 1919 and 1920.[a]

Mineral.		1919		1920	
		Quantity.	Value (pesetas).	Quantity.	Value (pesetas).
Alum	kilograms	80,000	22,000	770,000	346,500
Aluminous earth	tons	227	8,395	219	7,665
Amblygonite	do	70	7,000	20	10,000
Ammonium sulphate	do	4,280	3,239,733	2,207	1,863,050
Arsenic, white	kilograms	42,388	55,104	76,194	81,052
Asphalt, crude	tons	4,564	50,443	4,222	27,644
Barytes	do	11,459	278,205	13,773	556,466
Bauxite	do	1,780	89,000	540	27,000
Bismuth: Ore	do	75	225,000	53	91,711
Metal	kilograms	20,000	500,000	25,000	750,000
Briquets, fuel	tons	587,069	47,736,930	742,408	57,047,683
Cement: Natural	do	161,347	2,614,802	161,551	3,627,689
Portland	do	200,114	15,514,508	318,635	25,395,554
Clay	do	20	20	30	30
Coal: Anthracite	do	398,771	19,410,062	491,715	22,388,617
Bituminous	do	5,304,866	309,255,819	4,928,989	305,456,023
Lignite	do	539,872	19,426,203	552,425	21,071,853
Coke	do	331,000	58,293,676	280,717	28,198,975
Copper: Ore [b]	do	864,414	13,387,261	218,969	4,840,577
Blister	kilograms	10,216,200	24,911,804	9,790,000	24,044,240
Cement copper	do	10,950,809	15,006,603	11,168,000	20,666,934
Ingots and wire bars	do	2,252,000	6,709,692	1,500,000	5,250,000
Fluorspar	tons	280	1,050	416	15,808
Garnet	do	801	44,039	198	9,885
Glauberite	do			1,106	21,851
Gold ore	do			10	765
Graphite	do	1,958	127,800	6,315	355,170
Iron: Ore	do	4,640,061	45,418,344	4,767,693	54,240,401
Pig iron	do	294,167	(c)	251,412	72,881,420
Kaolin [d]	do	34	272	950	22,700
Lead: Ore	do	136,180	46,129,647	175,976	59,808,044
Work lead [e]	kilograms	80,639,451	48,320,998	[f] 175,195,872	133,308,390
Refined lead (soft lead)	do	43,423,000	19,757,465		
Antimonial lead	do	1,659,000	829,500		
Magnesium carbonate, crude	tons	120	2,400	1,214	32,580
Manganese ore	do	66,685	1,329,598	21,256	400,438
Manganiferous iron ore	do			2,100	31,500
Mica	do	7	10,500	5	4,500
Mineral paints: Ocher, crude	do	680	20,400	301	9,050
Red lead	do	860	1,204,000	1,025	1,435,000
White lead	do	2,228	3,336,890	2,859	4,282,830
Other pigments	do	4,489	599,240	8,796	1,514,623
Mineral waters	do	31,268,350	1,865,387	32,267,850	1,925,357
Molybdenum ores: Wulfenite	kilograms			56,250	74,212
Oil shale	tons	5,527	55,270		
Oil: Distilled from coal	do	4,000	(c)	770	536,600
Distilled from shale	do				
Phosphate rock	do	25,035	755,782	42,896	2,798,600
Pyrites: Arsenical	do	150	3,000	1,000	20,000
Cupreous-iron	do	605,677	11,881,249	643,224	9,580,146
Iron	do	431,189	5,139,423	711,823	6,581,929
Quicksilver: Ore	do	24,966	6,356,435	17,480	(c)
Metal	kilograms	1,226,568	19,479,822	861,689	11,922,348
Salt, common	tons	481,291	3,945,432	991,545	9,503,480
Silver, fine	kilograms	82,931	8,918,851	91,961	16,898,421
Silver-lead ores [g]	tons	41,952	10,332,015	10,527	721,079
Sodium sulphate, natural	do	3,230	85,330	299	16,922
Steatite	do	3,024	65,400	2,146	33,343
Sulphur: Ores	do	89,586	[h] 1,310,108	77,039	1,940,038
Refined	do	11,445	4,705,534	12,693	5,110,649
Sulphuric acid	do	73,379	10,007,753	125,764	18,709,060
Tar	do	17,936	1,830,115	9,313	1,708,325
Tin: Ore	do	154	129,688	144	104,250
Metal	kilograms	19,900	95,825	17,470	99,880
Tripoli	tons	110	7,150	597	41,790
Tungsten ores: Wolfram	do	337	234,600	62	46,900
Zinc: Ore	do	103,608	5,612,649	94,051	7,000,340
Crude zinc	kilograms	11,591,727	11,420,344	5,869,000	6,221,989
Refined zinc	do	462,000	693,000	509,000	661,700
Sheet zinc	do	4,260,000	5,538,000	3,269,000	5,884,200

[a] Estadística minera de España, Consejo de Minería, Madrid.
[b] Exclusive of cupreous-iron pyrites, for which see pyrites.
[c] Value not stated.
[d] In 1919 figures represent output of Province of Navarra only; in 1920, output of Province of Valencia only.
[e] Includes base bullion.
[f] Data not reported separately for 1920.
[g] Includes silver ores.
[h] Value of the output from the Province of Teruel not included. Output from this Province in 1919 was 37,475 tons.

SURINAM (DUTCH GUIANA).[1]

Large deposits of bauxite and iron ore have been located in Surinam but are not yet developed to the point of commercial production. Unimportant deposits of quicksilver on Maroni River have been worked in a small way, but data of output are not available.

The production and exports of crude gold in 1919 and 1920 were as follows: 1919, production, 598,161 grams, valued at 819,480 florins; exports, 556,642 grams, valued at 892,569 florins; 1920, production, 470,764 grams, valued at 644,946 florins; exports, 458,739 grams, valued at 706,561 florins.

SWAZILAND.

The only minerals reported produced in Swaziland are gold and tin concentrates.

Mineral production of Swaziland for the fiscal years ended March 31, 1920 and 1921.[a]

Mineral.	1919–20		1920–21	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Gold, fine....grams..	1,058	168	8,585	1,380
Tin concentrates....tons..	456	66,676	417	59,254

[a] Great Britain Colonial Reports, 1921: Swaziland.

SWEDEN.

Mineral production of Sweden, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (kronor).	Quantity.	Value (kronor).
Clay: Clinker clay....tons..	38,679	204,376	40,924	205,948
Fire clay....do....	118,079	1,004,086	116,827	595,758
Coal....do....	429,267	19,210,927	439,584	22,268,539
Copper: Ore....do....	7,279	911,207	1,136	42,530
Electrolytic copper [b]....kilograms..	561,191	3,737,954	23,590	42,460
Refined copper [c]....do....	2,997,101	11,187,664	1,265,284	2,251,900
Feldspar....tons..	12,905	183,425	12,049	233,976
Gold....grams..	21,552	52,436	7,610	20,507
Graphite....tons..	.....	.....	7	520
Iron: Ore....do....	4,981,110	71,585,036	4,519,112	67,932,757
Pig iron....do....	493,701	116,834,676	470,550	119,903,514
Sponge iron....do....	1,332	240,000	4,263	1,034,203
Lead: Work lead....kilograms..	411,660	246,996	1,325,087	708,107
Antimonial lead....do....	37,580	22,548	60,325	33,178
Refined lead [d]....do....	789,868	820,673	802,525	497,614
Litharge....do....	30,307	85,503	15,035	15,400
Manganese ore [e]....tons..	12,400	1,820,108	14,960	1,322,739
Molybdenum ores....kilograms..	80	400	600	5,400
Nickel ore....tons..	416	21,185	.....	.....
Pyrites, iron....do....	108,770	6,052,722	107,326	3,457,091
Quartz....do....	51,565	439,087	30,162	278,566
Silver....kilograms..	620	85,465	360	66,047
Silver-lead ore....tons..	1,671	472,760	2,901	845,197
Sodium, metallic....kilograms..	109,936	275,000	165,096	536,500
Tungsten ores: Wolfram....do....	28,226	51,000	30,536	74,736
Zinc: Ore....tons..	49,451	3,301,466	47,674	2,466,870
Crude zinc....kilograms..	2,806,368	2,666,050	1,605,800	867,132
Merchantable zinc: Common [f]....do....	.....	.....	4,639,400	3,632,650
Refined [g]....do....	2,320,538	2,459,770	1,120,100	967,766

[a] Sveriges officiella Statistik: Bergshantering, Kommerskollegium, Stockholm.

[b] Of the total output of electrolytic copper, the following quantities were made from imported material: 1919, 68,854 kilograms; 1920, total output, 23,590 kilograms.

[c] Of the total output of refined copper, the following quantities were made from imported material: 1919, 2,731,390 kilograms; 1920, 841,092 kilograms.

[d] Of the total output of refined lead the following quantities were made from imported material: 1919, 120,430 kilograms; 1920, none.

[e] Includes powdered pyrolusite.

[f] Of the total quantity of common merchantable zinc made in 1920, 3,850,700 kilograms were made from imported material.

[g] Of the total output of refined zinc, the following quantities were made from imported material: 1919, 243,827 kilograms; 1920, 158,900 kilograms.

[1] Data furnished by the governor of Surinam, Parimaribo.

SWITZERLAND.

The mineral resources of Switzerland are not sufficiently important to warrant exploitation on a large scale, and the mining industry is largely in the hands of small local enterprises. No official statistics covering the mineral production of the country have been published in recent years.

Deposits of asbestos, asphalt, barytes, clay, coal, fluorspar, graphite, gypsum, iron, lead, magnesium sulphate, oil shale, peat, pyrites, salt, slate, soapstone, building stones of various kinds, talc, and zinc are known to exist. Some of these minerals have been worked on a small scale for many years, chief among them being asbestos, asphalt, coal, gypsum, iron, peat, salt, slate, and building stone. Unofficial reports [1] give the production of asphalt, coal, and salt during 1920 as follows: Asphalt, 16,653 tons; coal, 74,590 tons; salt, 67,113 tons. Under the stress of the coal shortage during the World War and the years immediately subsequent, the peat bogs of Switzerland were extensively worked, the output in 1919 rising as high as 300,000 tons; but with the easing up of the fuel situation this industry declined, and the output for 1920 fell much below the figures for 1919.

TRINIDAD.

Mineral production of Trinidad, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Asphalt.....tons..	95,312	56,685	143,365	88,187
Limestone and road material.....do....	144,329	18,030	194,561	25,919
Manjak.....do....	211	866	136	698
Petroleum.....hectoliters..	2,927,743	295,453	3,312,555	379,302

[a] Inspector of Mines, Mines Dept., Trinidad, Administration Rept.

TUNIS.

Mineral production of Tunis, 1919 and 1920.

Mineral.	1919 [a]		1920 [b]	
	Tons.	Value (francs).	Tons.	Value (francs).
Cement	(c)	(c)	261	26,100
Clay: For brick and tile	11,000	33,000	12,708	157,272
For pottery	25	75	1,600	8,000
Coal (lignite)	36,551	(c)	31,331	2,349,825
Gypsum (plaster)	12,000	712,000	8,120	511,000
Iron ore	308,135	(c)	406,280	16,251,200
Lead: Ore	4,576	(c)	24,769	17,338,000
Metal (smelter product)	(c)	(c)	11,407	22,814,000
Lime	8,000	358,000	45,145	2,856,960
Manganese ore	1,313	91,910	1,300	130,000
Phosphate rock	822,000	(c)	1,075,180	91,390,300
Salt	16,942	(c)	41,086	821,920
Sand and gravel	31,000	155,000	46,107	272,165
Stone: Building stone, dressed	8,750	496,000	(c)	(c)
Other	331,600	3,334,000	(c)	(c)
Zinc ore	40,253	(c)	12,575	4,087,000
Zinc-lead ore	9,722	(c)	7,384	(c)

[a] Data compiled from Statistique de l'industrie minérale et des appareils à vapeur en France et en Algérie pour l'année 1919, Paris.
[b] Data furnished by the Direction Générale des Travaux Publics, Service des Mines, Tunis, through the American vice consul in charge, Tunis.
[c] Data not available.

[1] Information supplied by the American consul, Geneva.

TURKEY.

No geological survey of Turkey has ever been made, and consequently the mineral resources of the country are imperfectly known. The mineral wealth of Asiatic Turkey is generally believed to be great and that of Turkey in Europe inconsiderable. Some deposits of lignite and petroleum are reported to occur in European Turkey, but no important mining operations are in progress.

The following mineral deposits are known to exist in Asia Minor, some of which have been worked for centuries: Alunite, antimony, arsenic, asbestos, asphalt, bismuth, borax, chromite, clay, coal, copper, emery, gold, gypsum, iron, kaolin, lead, lithographic stone, magnesite, manganese, meerschaum, molybdenum, oil shale, pandermite, petroleum, phosphate rock, potash, iron pyrites, quicksilver, salt, silver, soapstone, building stones, sulphur, and zinc.

Coal is widely distributed throughout Asia Minor, but the only important workings are those of the Heraclea Basin, where both bituminous coal and lignite are produced.

The copper mines of Arghana Maden are considered the richest mining property in the country. The mines have been worked for more than 800 years, but are entirely without modern equipment.[1]

The emery mines of Smyrna are very productive, the pre-war average annual production being estimated at about 33,000 tons.[2]

The following table[3] gives the approximate average annual output of the more important minerals produced in Asia Minor:

Antimony ore	tons	1,500
Asphalt	do	7,000
Boracite	do	16,000
Chrome ore	do	15,000
Coal: Bituminous	do	730,000
Lignite	do	30,000
Copper ore	do	1,500
Emery [2]	do	33,000
Gold	kilograms	45
Iron pyrites	tons	20,000
Lead ore	do	13,000
Manganese ore	do	12,000
Meerschaum	do	250
Silver	kilograms	250
Zinc ore	tons	2,000

[1] Adams, H. W., acting commercial attaché, American embassy, Paris.
[2] Data furnished by the American consul general, Smyrna, Asia Minor.
[3] Data furnished by the American consul general, Constantinople, Turkey.

UNION OF SOUTH AFRICA.

Mineral production of the Union of South Africa, 1919 and 1920.[a]

[Marketed product.]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Ammonium sulphate.....tons..	3,413	102,930	1,673	63,088
Antimony, ore and concentrates.....do....	29	556	.....	.....
Arsenic, white.....do....	7	663	10	655
Asbestos.....do....	3,567	66,426	6,452	114,195
Bismuth ore.....kilograms..	336	300	.....	.....
Cement[b].....tons..	127,701	451,224	(c)	(c)
Coal.....do....	9,313,232	3,416,244	10,408,497	4,519,665
Coke.....do....	20,392	47,312	20,813	48,535
Copper[d].....do....	3,577	(c)	1,075	(c)
Corundum.....do....	162	1,486	237	1,446
Diamonds[e].....grams..	517,603	11,734,495	509,003	14,762,899
Fertilizers (quarry products).....	.....	15,811	.....	8,524
Flint.....	.....	1,311	.....	1,230
Fluorspar: Optical.....	.....	25	.....	.....
Other.....	.....	380	.....	4,000
Gold, fine[e].....grams..	259,143,349	35,390,609	253,756,350	34,654,922
Graphite.....tons..	78	2,630	66	2,339
Gypsum.....	.....	10,921	.....	14,098
Iron: Ore.....tons..	3,268	1,081	2,326	811
Pig iron[f].....do....	1,780	12,500	1,368	15,080
Lead ore.....do....	686	4,973	526	5,270
Lime[b].....do....	96,165	201,958	(c)	(c)
Magnesite.....do....	929	2,723	1,287	3,780
Manganese.....do....	141	776	61	277
Mica.....kilograms..	2,676	369	695	500
Mineral paints (iron oxide, ocher).....tons..	218	572	486	1,049
Pyrites, iron.....do....	5,019	8,894	3,147	5,014
Salt[b].....do....	77,268	193,067	(c)	(c)
Silver, fine[g].....grams..	27,722,657	228,804	27,762,749	245,871
Slate.....	.....	2,758	.....	4,417
Soda.....tons..	47	753	.....	.....
Steatite.....	.....	932	.....	.....
Stone: Granite for building, curbing.....	.....	24,033	.....	32,751
Limestone for building.....	.....	178	.....	.....
Sandstone for building.....	.....	11,926	.....	10,194
Verdite.....	.....	.....	.....	433
Talc.....tons..	687	2,170	619	2,227
Tar.....liters..	6,656	135	114,349	3,382
Tin concentrates.....tons..	1,479	277,925	2,234	435,680
Tungsten concentrates.....kilograms.	4,054	699	.....	.....
Zinc concentrates.....tons..	.....	.....	2,131	15,614

[a] Annual reports of the Secretary for Mines and Industries and the Government Mining Engineer, Department of Mines and Industries, Pretoria, South Africa.
[b] Data represent production during the census year ended June 30, 1919.
[c] Data not available.
[d] Estimated fine copper content of ores, matte, etc., produced.
[e] Data represent production, not sales.
[f] Produced from ore.
[g] Silver mostly contained in gold bullion.

Mineral production of the Union of South Africa, 1919 and 1920, by Provinces.

[Marketed product.]

Province and mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
CAPE OF GOOD HOPE.				
Asbestos.....tons..	2,906	57,578	3,199	71,875
Coal.....do....	4,317	3,750	5,171	4,399
Copper[a].....do....	988	.....	258	.....
Corundum.....do....	43	568	14	150
Diamonds[b].....grams..	298,971	7,605,053	272,941	9,463,512
Fertilizers, quarry products.....	.....	8,376	.....	2,833
Gold, fine[b].....grams..	249	34	591	82
Gypsum.....	.....	1,181	.....	1,234
Iron ore.....tons..	.....	.....	88	194
Lime.....	(c)	(c)	(d)	(d)
Salt.....	(c)	(c)	(d)	(d)

[a] Estimated fine copper content of ore, matte, etc., produced.
[b] Production, not sales.
[c] Data not available by Provinces.
[d] Data not available.

Mineral production of the Union of South Africa, 1919 and 1920, by Provinces—Contd.

Province and mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
CAPE OF GOOD HOPE—continued.				
Stone: Granite for building, etc		10,843		11,818
Limestone for building		178		
Sandstone for building		3,386		2,309
Tin concentrates [e] tons	29	5,007	10	2,314
Tungsten concentrates [f] kilograms	265	73		
NATAL.				
Ammonium sulphate tons	3,413	102,930	1,673	63,088
Asbestos do	89	1,149	41	1,137
Coal do	2,541,015	1,487,031	3,013,294	2,040,070
Coke do	20,392	47,312	20,771	48,454
Gold, fine [b] grams	10,855	1,484	6,532	893
Gypsum		2,778		3,728
Lime	(c)	(c)	(d)	(d)
Mineral paints (iron oxide, ocher, etc.) tons	176	342	463	949
Silver, fine grams	1,244	10	529	5
Steatite		932		
Stone: Granite for building, etc		1,474		1,706
Sandstone for building		2,506		587
ORANGE FREE STATE.				
Coal tons	760,270	231,332	876,367	287,515
Diamonds [b] grams	43,840	1,460,588	55,003	1,699,077
Gypsum		6,962		9,136
Lime	(c)	(c)	(d)	(d)
Salt	(c)	(c)	(d)	(d)
Stone: Sandstone for building		3,813		5,067
TRANSVAAL.				
Antimony, ore and concentrates [g] tons	29	556		
Arsenic, white do	7	663	10	655
Asbestos do	572	7,699	3,212	41,183
Bismuth ore [h] kilograms	336	300		
Coal tons	6,007,630	1,694,131	6,513,665	2,187,681
Coke do			42	81
Copper [a] do	2,589		817	
Corundum do	119	918	223	1,296
Diamonds [b] grams	174,792	2,668,854	181,059	3,600,310
Fertilizers, quarry products		7,435		5,691
Flint		1,311		1,230
Fluorspar: Optical		25		
Other		380		4,000
Gold, fine [b] grams	259,132,245	35,389,091	253,749,227	34,653,947
Graphite tons	78	2,630	66	2,339
Iron: Ore do	3,268	1,081	2,238	617
Pig iron [i] do	1,780	12,500	1,368	15,080
Lead ore [j] do	686	4,973	526	5,270
Lime	(c)	(c)	(d)	(d)
Magnesite tons	929	2,723	1,287	3,780
Manganese ores [k] do	141	776	61	277
Mica kilograms	2,676	369	695	500
Mineral paints (iron oxide, ocher) tons	42	230	23	100
Pyrites, iron do	5,019	8,894	3,147	5,014
Salt	(c)	(c)	(d)	(d)
Silver, fine grams	27,721,413	228,794	27,762,220	245,866
Slate		2,758		4,417
Soda tons	47	753		
Stone: Granite for building, etc		11,716		19,227
Sandstone for building		2,221		2,231
Verdite				433
Talc tons	687	2,170	619	2,227
Tar liters	6,656	135	114,349	3,382
Tin concentrates [l] tons	1,450	272,918	2,224	433,366
Tungsten concentrates [f] kilograms	3,789	626		
Zinc concentrates [m] tons			2,131	15,614

[a] Estimated fine copper content of ore, matte, etc., produced.
[b] Production, not sales.
[c] Data not available by Provinces.
[d] Data not available.
[e] Average metal content, 1919, 70.92 per cent; 1920, 74.15 per cent.
[f] Average metal content, 100 per cent.
[g] Average metal content, 1919, 45.69 per cent.
[h] Average metal content, 1919, 80 per cent.
[i] Made from ore.
[j] Average metal content, 1919, 45.92 per cent; 1920, 49.47 per cent.
[k] Average metal content, 1919, 48.67 per cent; 1920, 54.55 per cent.
[l] Average metal content, 1919, 76.35 per cent; 1920, 69.52 per cent.
[m] Average metal content, 1920, 52.64 per cent.

UNITED KINGDOM AND THE ISLE OF MAN.

Mineral production of the United Kingdom and the Isle of Man, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (pounds sterling).	Quantity.	Value (pounds sterling).
Alum shale ..... tons..	4,926	545	5,628	623
Arsenic ..... do....	2,568	100,222	2,029	110,873
Barytes ..... do....	61,051	198,550	65,180	207,218
Bauxite ..... do....	9,369	2,811	11,197	3,443
Bog ore ..... do....	3,094	761	2,214	1,127
Briquets (fuel) ..... do....	2,093,818	4,815,142	2,474,398	10,395,358
Chalk ..... do....	2,671,608	241,863	3,807,307	444,496
Chert, flint, etc ..... do....	50,886	15,348	85,656	35,260
Chromite ..... do....	152	150	1,118	1,100
Clay and shale [b] ..... do....	7,890,609	2,358,522	11,207,456	3,648,213
Coal: Anthracite ..... do....	4,304,248	6,426,283	4,611,810	9,681,923
Bituminous ..... do....	229,163,230	307,686,877	228,604,260	387,190,500
Lignite ..... do....			152	180
Coke: Gas-house ..... do....	8,009,868	[c] 40,653,387	8,440,471	59,568,810
Metallurgical ..... do....	[c] 11,868,635		12,813,848	
Copper: Concentrates ..... do....	146	1,120	82	479
Precipitate ..... do....	232	9,858	197	9,170
Metal [d] ..... do....	146	14,176	129	13,664
Fluorspar ..... do....	37,452	36,252	55,561	57,242
Fuller's earth [b]	(b)	(b)	(b)	(b)
Gold, fine [d] ..... grams..			1,089	147
Gold ore ..... tons..			1	150
Gypsum ..... do....	223,534	138,265	291,584	196,353
Iron: Ore [e] ..... do....	12,450,875	7,428,366	12,910,840	9,956,820
Pig iron [f] ..... do....	7,536,450	(g)	8,163,674	(g)
Lead: Concentrates ..... do....	14,090	256,377	15,646	325,174
Metal [d] ..... do....	10,442	289,769	11,137	419,030
Manganese ores ..... do....	12,272	29,111	13,082	26,991
Mica [b]	(b)	(b)	(b)	(b)
Mineral paint ores: Ocher, umber ..... tons..	10,716	17,483	15,786	29,768
Natural gas ..... cubic meters..	2,500	(g)	2,700	(g)
Oil shale ..... tons..	2,808,235	1,567,050	2,888,205	2,081,307
Petroleum ..... hectoliters..	3,021	(g)	4,626	8,437
Pyrites: Arsenical ..... tons..	76	667	1,197	7,212
Iron ..... do....	7,454	7,807	6,766	8,303
Salt: Brine ..... do....	1,846,307	2,026,293	2,083,194	2,377,015
Rock ..... do....	92,398	52,718	109,818	91,340
Sand and gravel ..... do....	2,081,304	336,421	2,801,302	532,236
Silver [d] ..... grams..	2,127,914	16,266	2,374,564	19,583
Slate ..... tons..	166,732	844,394	218,724	1,766,188
Soapstone ..... do....	699	1,011	367	900
Stone: Limestone, other than chalk ..... do....	9,690,572	2,431,627	11,408,023	3,519,506
Igneous rocks ..... do....	4,458,126	1,720,932	5,710,903	2,692,913
Sandstone (including ganister) ..... do....	1,727,136	971,329	2,218,866	1,606,493
Strontium, sulphate of ..... do....	1,902	[h] 4,210	4,250	[i] 3,638
Tin: Concentrates ..... do....	5,239	678,823	4,936	783,154
Metal [d] ..... do....	3,325	842,485	3,114	907,483
Tungsten ores ..... do....	169	19,255	96	3,524
Uranium ore ..... do....			61	1,800
Zinc: Ore ..... do....	7,044	62,202	5,145	33,815
Metal [d] ..... do....	2,475	102,951	1,682	74,847

[a] Mines and Quarries: General report, with statistics, Chief Inspector of Mines, Great Britain.

[b] Fuller's earth and scrap mica (mica clay) are included under clay, the production of scrap mica being as follows: 1919, 11,570 tons; 1920, 13,977 tons. The output of fuller's earth was 25,183 tons in 1919. Data of 1920 output are not available.

[c] Revised figures.

[d] Estimated quantity of metal obtainable by smelting from the ores raised in the United Kingdom.

[e] Exclusive of micaceous iron ore used for paint, which is included under mineral paint ores, the quantities thus used being as follows: 1919, 511 tons; 1920, 589 tons.

[f] Made from domestic and imported material.

[g] Data not available.

[h] Value of dressed ore.

[i] Value of crude ore.

Mineral production of the United Kingdom and the Isle of Man, 1919 and 1920, by States.[a]

State and mineral.	1919	1920
ENGLAND.		
Alum shale.....tons..	4,926	5,268
Arsenic.....do....	2,568	2,029
Barytes.....do....	49,269	53,283
Bog ore.....do....	1,921	1,913
Briquets (fuel)....do....	179,513	82,422
Chalk.....do....	2,553,502	3,659,808
Chert, flint, etc....do....	48,659	84,297
Clay and shale....do....	[b] 6,624,639	[c] 9,589,350
Coal, bituminous..do....	163,086,063	164,695,833
Coke:		
Gas house.....do....	6,955,209	7,304,768
Metallurgical..do....	10,784,006	[d] 12,297,202
Copper:		
Concentrates..do....	69	82
Precipitate....do....	98	119
Fluorspar.....do....	37,452	55,561
Fuller's earth.....do....	25,183	(*e*)
Gypsum.....do....	223,096	290,870
Iron:		
Ore.....do....	12,054,008	12,548,903
Pig iron.....do....	6,135,038	6,543,512
Lead concentrates.do....	8,236	7,699
Mica, scrap.....do....	11,570	13,977
Mineral paint ores:		
Ocher, etc.....tons..	9,262	14,018
Natural gas.....		
.....cubic meters..	2,500	2,700
Oil shale.....tons..	620	1,750
Petroleum, hectoliters..	3,021	4,626
Pyrites:		
Arsenical.....tons..	76	1,197
Iron.....do....	6,915	6,301
Salt:		
Brine.....do....	[f] 1,842,851	2,070,792
Rock.....do....	72,545	86,358
Sand and gravel...do....	1,626,949	2,273,002
Slate.....do....	15,464	17,592
Stone:		
Limestone other than chalk..tons..	7,649,068	9,157,536
Igneous rocks.do....	2,224,860	2,936,797
Sandstone (including ganister).tons..	1,106,740	1,478,355
Strontium, sulphate of .....tons..	1,902	4,250
Tin:		
Concentrates..do....	5,239	4,936
Metal[g].....do....	3,325	3,114
Tungsten ores.....do....	169	96
Uranium ore.....do....	.....	61
Zinc ore.....do....	4,520	2,148
SCOTLAND.		
Barytes.....tons..	3,604	5,331
Briquets (fuel)....do....	112,258	140,909
Chromite.....do....	152	1,118
Clay and shale....do....	841,642	979,974
Coal:		
Anthracite[h]...do....	226,230	219,720
Bituminous...do....	32,752,583	31,810,180
Coke:		
Gas house.....do....	701,904	768,526
Metallurgical..do....	540,715	516,646
Iron:		
Ore.....do....	313,676	283,867
Pig iron.....do....	917,875	917,036
Lead concentrates.do....	3,820	6,011
Oil shale.....do....	2,807,615	2,886,455
Salt: Brine.....do....	79	(*i*)
Sand and gravel...do....	360,926	434,727
Slate.....do....	1,639	3,499
SCOTLAND—continued.		
Stone:		
Limestone....tons..	226,249	295,892
Igneous rocks.do....	1,218,602	1,427,507
Sandstone (including ganister).tons..	134,633	200,534
Zinc ore.....do....	616	1,410
WALES.		
Barytes.....tons..	3,000	2,381
Briquets (fuel)....do....	1,800,212	2,249,654
Chert, flint, etc....do....	915	1,120
Clay and shale....do....	317,513	525,192
Coal:		
Anthracite....do....	3,998,849	4,299,874
Bituminous...do....	33,309,857	32,080,770
Coke:		
Gas house.....do....	158,489	161,059
Metallurgical..do....	543,914	(*d*)
Copper:		
Concentrates..do....	77	.....
Precipitate....do....	134	78
Gold ore.....do....	.....	1
Iron:		
Ore.....do....	67,013	49,321
Pig iron.....do....	483,537	703,126
Lead concentrates.do....	1,879	1,832
Manganese ore....do....	12,272	13,081
Mineral paint ores:		
Ocher, etc.....tons..	440	567
Pyrites, iron.....do....	61	64
Sand and gravel...do....	9,425	23,167
Slate.....do....	144,801	195,993
Stone:		
Limestone....do....	1,573,178	1,805,039
Igneous rocks.do....	697,019	932,466
Sandstone (including ganister).tons..	401,660	468,913
Zinc ore.....do....	1,073	1,009
IRELAND.		
Barytes.....tons..	5,178	4,185
Bauxite.....do....	9,369	11,197
Bog ore.....do....	1,173	301
Briquets (fuel)....do....	1,835	1,413
Chalk.....do....	118,106	147,499
Chert, flint, etc....do....	1,312	239
Clay and shale....do....	68,385	96,728
Coal:		
Anthracite....do....	79,169	92,216
Bituminous...do....	14,727	17,477
Lignite.....do....	.....	152
Coke, gas-house...do....	185,121	195,442
Gypsum.....do....	438	714
Iron ore.....do....	16,158	28,749
Lead concentrates.do....	24	25
Mineral paint ores:		
Ocher, etc.....tons..	1,014	1,201
Pyrites, iron.....do....	478	401
Salt:		
Brine.....do....	(*f*)	(*i*)
Rock.....do....	19,853	23,459
Sand and gravel...do....	83,841	70,406
Slate.....do....	4,384	982
Soapstone.....do....	699	367
Stone:		
Limestone other than chalk..tons..	240,056	147,575
Igneous rocks.do....	304,547	393,963
Sandstone (including ganister).tons..	84,103	70,078
Zinc ore.....do....	35	41

[a] Mines and Quarries: General report, with statistics, Chief Inspector of Mines, Great Britain.
[b] Exclusive of scrap mica and fuller's earth.
[c] Exclusive of scrap mica, but inclusive of fuller's earth.
[d] Output of metallurgical coke for Wales in 1920 included under England.
[e] Data not available.
[f] Output of brine salt in Ireland in 1919 included under England.
[g] Estimated metal content of ore.
[h] Estimated output.
[i] Data not available. The total output for Scotland, Ireland, and the Isle of Man in 1920 reported as 12,402 tons.

Mineral production of the United Kingdom and the Isle of Man, 1919 and 1920, by States—Continued.

State and mineral.	1919	1920	State and mineral.	1919	1920
ISLE OF MAN.			ISLE OF MAN—continued.		
Clay and shale....tons..	1,677	2,235	Stone:		
Coke, gas-house...do....	9,145	10,676	Limestone....tons..	2,021	1,982
Lead concentrates..do....	131	79	Igneous rocks..do....	13,098	20,170
Salt, brine.....do....	3,377	(*i*)	Sandstone (including anister).tons..	.....	987
Sand and gravel...do....	163	.....	Zinc ore.....do....	800	537
Slate.....do....	444	658			

i Data not available. The total output for Scotland, Ireland, and the Isle of Man in 1920 reported as 12,402 tons.

VENEZUELA.

Mineral production of Venezuela, 1919 and 1920.[a]

Mineral.	1919		1920	
	Quantity.	Value (bolivars).	Quantity.	Value (bolivars).
Asbestos[b].....kilograms..	.....	.....	950	400
Asphalt.....tons..	45,936	1,837,440	23,452	938,080
Cement[c].....do....	(*c*)	(*c*)	(*c*)	(*c*)
Coal[d].....do....	33,287	1,167,426	30,377	1,291,141
Copper, metal.....do....	[e] 188	(*f*)	(*f*)	(*f*)
Gold.....grams..	653,457	1,868,887	585,977	1,675,896
Magnesite[b].....kilograms..	.....	.....	2,000,000	40,000
Manganese[b].....do....	.....	.....	2,790	120
Petroleum.....tons..	64,628	(*f*)	69,539	3,476,950
Salt, from sea water[b].....kilcgrams..	915,009	135,000	840,000	158,125

[a] Memoria del Ministerio de Fomento, Bol. comercial é industrial, Bol. Ministerio de Fomento, Caracas; data furnished by the American legation, Caracas, and the American consul, La Guaira.

[b] Exports.

[c] Cement is produced by one company. No data of production are available, but it is known that output is far below the country's requirements.

[d] Includes the output of the State of Falcón.

[e] The mineral industry of the British Empire and foreign countries, Imp. Mineral Resources Bur., London.

[f] Data not available.

YUGOSLAVIA.

The mineral resources of the new Kingdom of the Serbs, Croats, and Slovenes are rich and varied and embrace practically all the more essential minerals, among them being antimony, arsenic, asbestos, asphalt, barytes, bauxite, bismuth, chrome ores, clay, coal, copper, gold, graphite, gypsum, iron, kaolin, lead, magnesite, manganese, marl, meerschaum, mineral waters, molybdenum, natural gas, nickel, oil shale, peat, petroleum, iron pyrites, quicksilver, salt, silver, marble and other building and ornamental stones, sulphur, and zinc.

The mining industry of the country was well developed for many years before the World War, and a great number of mines had been in operation a long time; some new enterprises, however, were intensively developed to meet the urgent need of war material, of which the supply had been cut off by the blockade.

No statistics of the mineral production of the Kingdom are available.

IRON ORE, PIG IRON, AND STEEL.[1]

By Ernest F. Burchard and Hubert W. Davis.

INTRODUCTION.

The progress of the American iron industry, which was seriously checked during the last three months of 1920, was retarded to a greater degree until after the middle of 1921, and although there was a slight revival in some lines later, the year viewed as a whole may well be regarded as a period of severe depression and great uncertainty in the industry. Conditions were regarded as unsatisfactory in 1920, but the records made during that year now seem enviable; and the contrast between the two years becomes striking when it is noted that the domestic iron ore produced in 1921 amounted to 44 per cent of that in 1920, the pig iron to 45 per cent, and the steel to 47 per cent. The output of iron ore in 1921 was the lowest since 1904. The production in 1921 was about 42 per cent of the average of the preceding 5 years and about 49 per cent of the average of the preceding 10 years. The pig iron manufactured in 1921 was about 45 per cent of the average for the preceding 5 years, not quite 52 per cent of the average for the preceding 10 years, and the smallest quantity manufactured since 1908.

Prices decreased greatly, the average for iron ore at the mines by 18 per cent, and that of pig iron at the blast furnaces by about 24 per cent. Labor was obliged to accept reductions in wages and many iron and steel companies are reported to have sustained heavy financial losses.

Curtailment of buying, which has been more or less manifest in the years since the war, was more prevalent than in other recent years, but the ultimate consumer who bought iron and steel products at retail benefited very little by the reduced prices received by manufacturers, the excuse for high retail prices being high wages and high freight rates. The consumption was greater than is indicated by the records of production, as stocks of metal were heavily drawn upon in an effort on the part of jobbers and consumers to reduce their inventories. Notwithstanding the greatly curtailed output of iron ore, however, consumption did not keep pace with production and stocks of ore increased nearly 22 per cent.

In recent annual reviews of the iron industry it has been necessary to comment on the handicaps imposed by labor troubles, but during 1921 the industry seems to have had less labor trouble than usual. Reductions in wages followed reductions in prices, and there was not enough work at mines, blast furnaces, and steel mills to keep the normal force busy for more than part time, but in view of the

[1] The statistics of imports and exports in this chapter were compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

large increase in stocks of ore accumulated it is evident that more work was provided at many mines than was actually warranted by the demand for ore.

The total production of iron and steel by the principal producing countries of the world in 1921 decreased about in the same proportion as that in the United States, the so-called "world's production" having been about one-half of the manufacturing capacity. According to estimates by the Iron Trade Review [2] the "world's production" of pig iron in 1921 was not quite 36,000,000 gross tons, which is less than the production of the United States in 1920. The leading producers, such as the United States, Great Britain, and Belgium, suffered the greatest depression; France just about held her own; but certain central European countries, such as Germany, Luxemburg, Austria, Poland, Russia, and Hungary, produced more pig iron and steel in 1921 than in 1920. The gains in these countries of central Europe may be explained by their subnormal productive ability in the years immediately following the war.

Exports of iron and steel by the United States in 1921 showed a decrease of 51 per cent as compared with 1920, and those of Great Britain fell off 49 per cent, but those of France and Germany gained 42 and 28 per cent, respectively. The foreign trade of the United States in iron and steel has shown disappointing decreases since the war, caused no doubt by efforts on the part of war-crippled European nations to rehabilitate their own iron and steel industries and to more aggressive work on the part of competitors.

Great depths of depression were reached in the several branches of the iron and steel industry during 1921, but at the end of the year the pendulum was swinging upward and the outlook for 1922 was decidedly brighter.

IRON ORE.

QUANTITIES MINED AND SHIPPED IN 1921.

The iron ore mined in the United States in 1921, exclusive of that containing 5 per cent or more of manganese,[3] is shown in the accompanying table, which includes beneficiated ore instead of crude ore mined if the ore is treated in any way. The quantities of ore, both mined and shipped, stated in the table, include the iron ore used for fluxing other metallic ores at smelters in the Western States, but the shipments do not include the iron ore sold for the manufacture of paint, which amounted in 1921 to 10,379 gross tons, valued at $56,824, or $5.47 a ton, compared with 24,448 tons, valued at $112,364, or $4.60 a ton, in 1920.

Iron ore was mined in 22 States in 1921, as compared with 25 States in 1920, Arizona, Connecticut, Maryland, and Washington having dropped out and Texas having been added. Idaho, Montana, and Utah produced iron ore for flux only; part of the production of California, Michigan, Misssouri, and Wyoming was used for flux; a small quantity of ore from Virginia was used in the manufacture of hydrogen gas; some of the ore from Pennsylvania was used for gas purification; the remaining States produced iron ore mainly for

[2] World's output at lowest ebb: Iron Trade Review, Jan. 5, 1922, pp. 22–23.

[3] The production of manganiferous iron ore is stated in the chapter on manganese and manganiferous ores in Mineral Resources for 1921.

use in blast furnaces, except small quantities used for paint from Georgia, Michigan, Minnesota, Nevada, New Jersey, New York, Pennsylvania, Tennessee, and Wisconsin. The rank of the three States producing the largest quantity of iron ore—Minnesota, Michigan, and Alabama—remained practically unchanged. The Minnesota iron ranges are producing more iron ore than all the rest of the States together, having furnished between 58 and 61 per cent of the total for the United States in recent years.

The ores of iron are generally classed under the four heads, hematite, brown ore, magnetite, and carbonate.[4]

Iron ore mined in the United States in 1920 and 1921, by States and varieties, in gross tons, with percentage of increase or decrease in 1921.

State.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.	Percentage of increase or decrease in 1921.
1920.						
Alabama	5,169,782	724,229	.....	.....	5,894,011	.....
Arizona	.....	.....	950	.....	950	.....
California	.....	1,094	5,573	.....	6,667	.....
Colorado	.....	1,914	.....	.....	1,914	.....
Connecticut	.....	3,700	.....	.....	3,700	.....
Georgia	38,794	65,717	.....	.....	104,511	.....
Idaho	.....	275	.....	.....	275	.....
Maryland	304	800	.....	.....	1,104	.....
Massachusetts	.....	6,639	.....	.....	6,639	.....
Michigan	17,510,742	.....	.....	.....	17,510,742	.....
Minnesota	39,453,173	.....	.....	.....	39,453,173	.....
Missouri	42,754	12,240	.....	.....	54,994	.....
Montana	1,142	1,573	8,088	.....	10,803	.....
Nevada	.....	238	.....	.....	238	.....
New Jersey	.....	.....	431,567	.....	431,567	.....
New Mexico	[a] 19,359	.....	[b] 254,860	.....	274,219	.....
New York	21,621	.....	898,388	.....	920,009	.....
North Carolina	.....	27,328	44,482	.....	71,810	.....
Pennsylvania	.....	1,892	728,751	3,740	734,383	.....
Tennessee	167,066	208,472	.....	.....	375,538	.....
Utah	(b)	[b] 19,777	16,382	.....	36,159	.....
Virginia	71,151	249,773	.....	.....	320,924	.....
Washington	.....	.....	2,500	.....	2,500	.....
Wisconsin	981,134	.....	.....	.....	981,134	.....
Wyoming	406,501	.....	.....	.....	406,501	.....
	[a b] 63,883,523	[b] 1,325,661	[a] 2,391,541	3,740	67,604,465	.....
1921.						
Alabama	2,644,020	232,121	.....	.....	2,876,141	−51
California	.....	.....	2,064	.....	2,064	−69
Colorado	.....	3,823	.....	.....	3,823	+100
Georgia	1,009	4,547	.....	.....	5,556	−95
Idaho	.....	799	.....	.....	799	+191
Massachusetts	.....	4,100	.....	.....	4,100	−38
Michigan	7,283,492	.....	.....	.....	7,283,492	−58
Minnesota	17,811,325	.....	.....	.....	17,811,325	−55
Missouri	36,550	.....	.....	.....	36,550	−34
Montana	5,239	3,695	17,240	.....	26,174	+142
Nevada	.....	268	.....	.....	268	+13
New Jersey	.....	.....	58,589	.....	58,589	−86
New Mexico	[a] 43,146	.....	[a] 67,382	.....	110,528	−60
New York	2,445	.....	467,543	.....	469,988	−49
North Carolina	.....	2,583	.....	.....	2,583	−96
Pennsylvania	.....	974	142,966	2,709	146,649	−80
Tennessee	13,416	12,293	.....	.....	25,709	−93
Texas	.....	131	.....	.....	131	.....
Utah	(b)	[b] 35,691	25,082	.....	60,773	+68
Virginia	4,892	69,129	.....	.....	74,021	−77
Wisconsin	257,014	.....	.....	.....	257,014	−74
Wyoming	234,701	.....	.....	.....	234,701	−42
	[a b] 28,337,249	[b] 370,154	[a] 780,866	2,709	29,490,978	−56

[a] Some magnetite included with hematite. [b] Some hematite included with brown ore.

[4] Notes concerning the composition of these ores are given in U. S. Geol. Survey Mineral Resources, 1916, pt. 1, pp. 537-541, 1918.

The ore reported as sold for fluxing other than in the manufacture of pig iron amounted to 89,959 gross tons, valued at $265,968, in 1921, as compared with 50,351 tons, valued at $245,117, in 1920. The ore reported as sold for purifying gas and for the manufacture of hydrogen amounted to 1,101 gross tons, valued at $9,980, compared with 2,108 tons, valued at $24,094, in 1920. The domestic iron ore sold for the manufacture of pig iron amounted to 26,561,468 gross tons, valued at $89,469,360, compared with 69,228,882 tons, valued at $284,737,116, in 1920.

A comparison of the annual production of iron ore and its derived metals since 1870 is afforded by the curves shown in figure 11. It must be borne in mind, however, that the figures for the three products are not strictly comparable, because considerable foreign iron ore and also some cinder, scale, and scrap enter into the production of domestic pig iron, and considerable quantities of scrap iron and steel, as well as cinder and scale, enter into the production of new steel.

Iron ore shipped from mines in the United States, 1920 and 1921, by States.

State.	1920		1921					
					Increase or decrease.		Percentage of increase or decrease.	
	Gross tons.	Value.	Gross tons.	Value.	Gross tons.	Value.	Quantity.	Value.
Alabama	5,833,317	$15,993,985	2,835,761	$5,058,161	−2,997,556	−$10,935,824	−51	−68
California	6,592	44,844	2,064	15,364	−4,528	−29,480	−69	−66
Georgia	104,482	460,633	3,822	13,678	−100,660	−446,955	−96	−97
Michigan	18,862,578	85,749,217	5,011,804	18,481,225	−13,850,774	−67,267,992	−73	−78
Minnesota	39,747,594	163,538,054	17,648,603	62,780,754	−22,098,991	−100,757,300	−56	−62
Missouri	50,825	230,827	(a)	(a)	(b)	(b)	(b)	(b)
Montana	10,803	73,889	26,174	91,729	+15,371	+17,840	+142	+24
New Jersey	417,100	2,595,949	115,132	551,688	−301,968	−2,044,261	−72	−79
New Mexico	274,705	547,370	110,528	244,284	−164,177	−303,086	−60	−55
New York	959,408	6,263,252	174,368	946,366	−785,040	−5,316,886	−82	−85
North Carolina	71,810	293,382	(a)	(a)	(b)	(b)	(b)	(b)
Pennsylvania	719,813	1,406,929	187,062	288,955	−532,751	−1,117,974	−74	−79
Tennessee	373,012	1,355,217	25,219	68,726	−347,793	−1,286,491	−93	−95
Utah	36,159	151,174	60,773	156,865	+24,614	+5,691	+68	+4
Virginia	320,109	1,227,601	54,353	196,935	−265,756	−1,030,666	−83	−84
Wisconsin	1,067,159	4,333,307	117,755	300,954	−949,404	−4,032,353	−89	−93
Other States	425,875	740,697	279,110	549,624	−b269,400	−b715,282	−b49	−b57
	69,281,341	285,006,327	26,652,528	89,745,308	−42,628,813	−195,261,019	−62	−69

a Less than three shippers in Missouri and North Carolina in 1921 and permission not granted to publish State totals. Figures for these States therefore included under "Other States."

b Decrease for Missouri and North Carolina included under "Other States."

c 1920: Arizona, Colorado, Connecticut, Idaho, Maryland, Massachusetts, Nevada, Washington, and Wyoming; 1921: Colorado, Idaho, Maryland, Massachusetts, Missouri, North Carolina, Texas, and Wyoming.

The Lake Superior district, comprising Minnesota, Michigan, and northern Wisconsin, mined about 86 per cent of the total ore in 1920 and 1921. The Birmingham district, Alabama, mined a little more than 9 per cent of the total, and the Adirondack district, New York, between 1 and 2 per cent of the total.

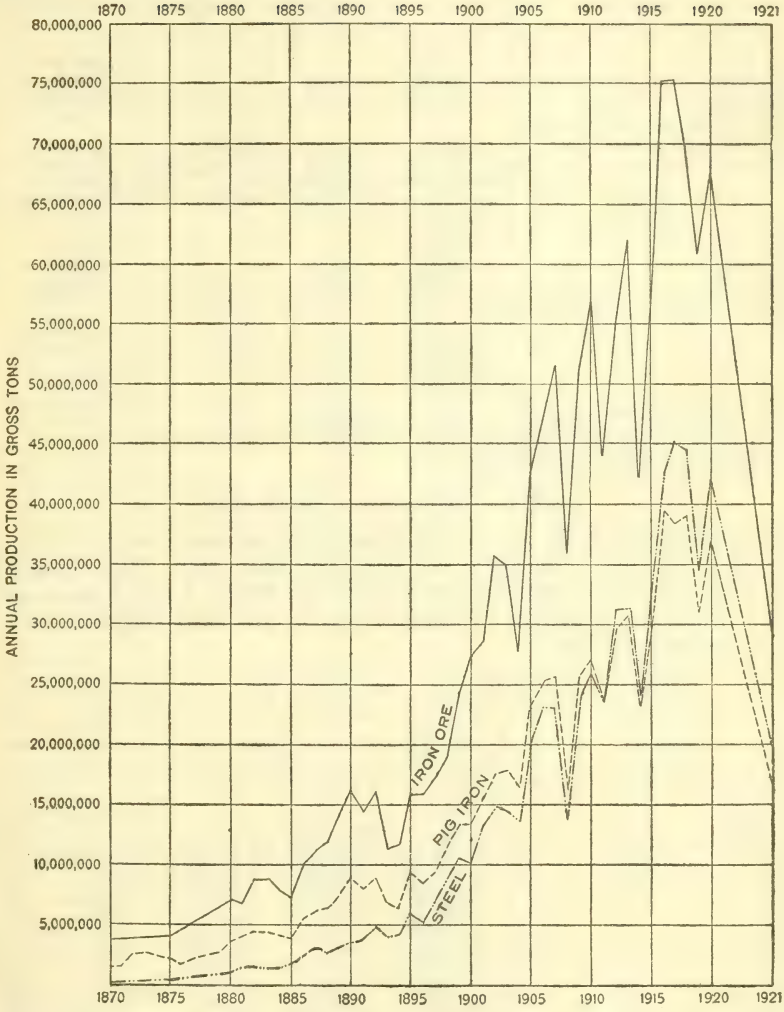

FIGURE 11.—Curves showing annual production of iron ore, pig iron, and steel in the United States, 1870–1921.

Iron ore[a] mined in the United States, by mining districts and varieties, in 1920 and 1921, in gross tons.

District.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.	Percentage of decrease in 1921.
1920.						
Lake Superior[b]	57,860,530				57,860,530	
Birmingham	4,953,653	266,561			5,220,214	
Chattanooga	393,733	187,184			580,917	
Adirondack			783,590		783,590	
Northern New Jersey and southeastern New York			546,365		546,365	
Other districts	[c d] 675,607	[d] 871,916	[c] 1,061,586	3,740	2,612,849	
	[c d] 63,883,523	[d] 1,325,661	[c] 2,391,541	3,740	67,604,465	
1921.						
Lake Superior[b]	25,288,485				25,298,485	56
Birmingham	2,548,349	180,124			2,728,473	48
Chattanooga	110,096	54,799			164,895	72
Adirondack			446,619		446,619	43
Northern New Jersey and southeastern New York			79,513		79,513	85
Other districts	[c d] 380,319	[d] 135,231	[c] 254,734	2,709	772,993	70
	[c d] 28,337,249	[d] 370,154	[c] 780,866	2,709	29,490,978	56

[a] Exclusive of ore containing 5 per cent or more of manganese.
[b] Includes only those mines in Wisconsin which are in the true Lake Superior district.
[c] Some magnetite included with hematite.
[d] Some hematite included with brown ore.

TOTAL OUTPUT OF IRON ORE.

The following table shows the production of iron ore in the United States as far as it has been recorded or estimated. The figures for the years prior to 1880 are not strictly accurate, having been calculated from the pig iron produced, which included imported ore as well as domestic ore.

Iron ore mined in the United States, 1810–1921, in gross tons.

Year.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
1810–1869					49,656,000
1870[a]–1880					51,690,889
1881–1890					103,854,386
1891–1900	136,961,046	22,845,764	14,634,364	1,065,137	175,506,311
1901–1910	364,179,432	[b] 28,287,994	[b] 20,664,453	262,366	413,394,245
1911	39,626,224	2,032,094	2,202,527	15,707	43,876,552
1912	51,345,782	1,614,486	2,179,533	10,346	55,150,147
1913	57,933,251	1,682,063	2,357,274	7,849	61,980,437
1914	38,286,670	1,537,750	1,610,203	5,138	41,439,761
1915	52,227,324	1,488,709	1,807,002	3,455	55,526,490
1916	70,728,024	1,904,484	2,533,364	1,800	75,167,672
1917	70,743,513	1,992,332	2,553,006		75,288,851
1918	65,894,709	1,613,844	2,149,725		69,658,278
1919	[c] 57,719,582	1,127,397	[c] 2,118,439		60,965,418
1920	[c d] 63,883,523	[d] 1,325,661	[c] 2,391,541	3,740	67,604,465
1921	[c d] 28,337,249	[d] 370,154	[c] 780,866	2,709	29,490,978
					1,430,250,880

[a] Includes ore produced by owners of blast furnaces, estimated by census at 800,000 tons.
[b] Some brown ore included with magnetite.
[c] Some magnetite included with hematite.
[d] Some hematite included with brown ore.

PRINCIPAL IRON-ORE MINES.

In 1921 there were 256 mines active, compared with 403 in 1920 and 389 in 1919, and 65 mines produced more than 100,000 gross tons of iron ore each, compared with 160 in 1920 and 144 in 1919.

Of these 65 mines 5 (3 in Minnesota, 1 in Alabama, and 1 in Michigan) produced more than 1,000,000 tons each, as against 9 (6 in Minnesota, 2 in Michigan, and 1 in Alabama) in 1920 and 1919. Permission has been granted to the Geological Survey by the owners and operators of these large mines to publish their production, and these statistics are given in the following table:

Iron-ore mines of the United States that produced more than 100,000 gross tons each in 1921.

Rank.	Name of mine.	State.	Nearest town.	Variety of ore.	Gross tons.
1	Hull-Rust	Minnesota	Hibbing	Hematite	3,719,256
2	Red Mountain group	Alabama	Bessemer	do	1,835,203
3	Missabe Mountain	Minnesota	Virginia	do	1,816,178
4	Norrie group	Michigan	Ironwood	do	1,151,086
5	Canisteo	Minnesota	Coleraine	do	1,128,933
6	Spruce	do	Eveleth	do	827,144
7	Pioneer	do	Ely	do	568,976
8	Kerr	do	Hibbing	do	547,043
9	Leonidas	do	Eveleth	do	491,635
10	Dunwoody	do	Hibbing	do	480,720
11	Plymouth	Michigan	Verona	do	428,112
12	Woodward Nos. 1, 2, and 3	Alabama	Woodward	do	417,382
13	Holman	Minnesota	Taconite	do	378,577
14	Bennett	do	Keewatin	do	328,469
15	Fayal	do	Eveleth	do	312,935
16	Miller	do	Aurora	do	307,197
17	Mahoning	do	Hibbing	do	303,020
18	Hill-Trumbull	do	Marble	do	299,899
19	Chisholm	do	Chisholm	do	290,655
20	Chapin	Michigan	Iron Mountain	do	284,730
21	Hawkins	Minnesota	Nashwauk	do	284,450
22	Sellers	do	Hibbing	do	280,850
23	North Harrison	do	Nashwauk	do	265,575
24	Dean	do	Buhl	do	261,703
25	Negaunee	Michigan	Negaunee	do	256,635
26	Sunrise	Wyoming	Sunrise	do	234,701
27	Sweeney	Minnesota	Hibbing	do	226,739
28	Patrick	do	Nashwauk	do	224,985
29	Tilden	Michigan	Bessemer	do	223,828
30	Newport	do	Ironwood	do	223,229
31	Lake Superior	do	Ishpeming	do	222,292
32	Burt	Minnesota	Hibbing	do	218,866
33	Armour No. 2	do	Crosby	do	217,151
34	Hobart	do	Gilbert	do	215,957
35	Morris-Lloyd	Michigan	Ishpeming	do	209,034
36	Maas	do	Negaunee	do	208,288
37	Zenith	Minnesota	Ely	do	208,232
38	Leonard	do	Chisholm	do	203,904
39	Stephenson	Michigan	Gwinn	do	195,539
40	Leetonia	Minnesota	Hibbing	do	186,383
41	Holmes	Michigan	Ishpeming	do	178,000
42	Athens	do	Negaunee	do	176,077
43	Penn group	do	Norway and Vulcan	do	168,156
44	Aragon	do	Norway	do	168,087
45	Old Bed	New York	Mineville	Magnetite	162,770
46	Wanless	Minnesota	Buhl	Hematite	146,807
47	Harmony	New York	Mineville	Magnetite	145,467
48	Palms	Michigan	Bessemer	Hematite	143,978
49	Biwabik (including Cincinnati).	Minnesota	Biwabik	do	139,978
50	La Rue	do	Nashwauk	do	135,214
51	Baltic (including Fogarty).	Michigan	Palatka	do	134,969
52	Homer	do	Iron River	do	130,324
53	Puritan	do	Ironwood	do	128,088
54	Riverton group	do	Iron River	do	127,641
55	Genoa	Minnesota	Gilbert	do	127,305
56	Morris	do	Hibbing	do	126,218
57	Cornwall	Pennsylvania	Miners Village	Magnetite	118,483
58	Davidson No. 1	Michigan	Iron River	Hematite	114,412
59	Philbin	Minnesota	Hibbing	do	107,622
60	Woodbridge	do	Buhl	do	107,252
61	Chester	do	Chisholm	do	104,618
62	Itasca	do	Buhl	do	103,772
63	Clark	do	Chisholm	do	103,507
64	Adams	do	Eveleth	do	102,299
65	Hillcrest	do	Ironton	do	100,768
	Total (65 mines)				23,788,223
	Output of 45 mines producing between 50,000 and 100,000 gross tons each				3,528,190
	Output of 146 mines producing less than 50,000 gross tons each				2,174,565
	Grand total of United States				29,490,978

STOCK OF IRON ORE AT MINES.

According to the reports of producers the total quantity of iron ore in stock at the mines at the end of 1921 amounted to 13,836,267 gross tons, compared with 11,378,794 tons at the end of 1920, an increase of 22 per cent. As the quantity of ore in stock piles is of necessity partly estimated, there are variations in the mine reports from year to year which prevent an absolute balance between the quantity mined and the quantity sold plus stocks on hand.

Stock of iron ore at mines, by States, December 31, 1920 and 1921, in gross tons.

State.	1920	1921	State.	1920	1921
Alabama	463,341	503,721	New Jersey	269,298	208,657
California	70	.....	New York	154,669	446,879
Georgia	3,885	4,610	North Carolina	.....	2,200
Iowa	12,165	12,165	Pennsylvania	54,400	8,405
Maryland	1,580	.....	Tennessee	3,709	3,709
Massachusetts	1,530	4,368	Virginia	42,630	62,298
Michigan	5,532,368	7,879,344	Wisconsin	341,212	460,161
Minnesota	4,493,158	4,234,952			
Missouri	4,779	4,798		11,378,794	13,836,267

PRICES OF IRON ORE PER TON.

In the following table the average selling price at the mines of the different classes of iron ore in 1920 and 1921 is given for each of the producing States or group of States, except where there were less than three producers or shippers of a certain variety of ore in a State and permission was not given to publish the prices. These figures are taken directly from statements of the producers and probably represent the selling prices only approximately, as some of the reports evidently include merely mining costs; others contain, in addition, the cost of selling and insuring the ore; in others an allowance for sinking fund is included, and in still others the figures given are the costs charged against the blast furnaces. None of the reports, however, include cost of freight.

Average price per gross ton of iron ore at mines in the United States in 1920 and 1921.

State.	Hematite.		Brown ore.		Magnetite.	
	1920	1921	1920	1921	1920	1921
Alabama	$2.52	$1.72	$4.26	$2.50	.....	.....
California	.....	.....	(a)	.....	$7.16	$7.44
Georgia	4.00	.....	4.62	3.58	.....	.....
Michigan	4.55	3.69	.....	.....	.....	.....
Minnesota	4.11	3.56	.....	.....	.....	.....
Missouri	4.44	(a)	4.96	.....	.....	.....
Montana	(a)	(a)	8.00	4.88	6.65	3.41
New Jersey	.....	.....	(a)	(a)	6.24	4.75
New Mexico	1.90	2.23	.....	.....	(a)	(a)
New York	(a)	.....	.....	.....	6.56	5.43
North Carolina	.....	.....	4.05	(a)	(a)	.....
Pennsylvania	.....	.....	(a)	(a)	1.93	1.51
Tennessee	(a)	(a)	4.05	(a)	.....	.....
Utah	.....	.....	3.92	(a)	(a)	(a)
Virginia	4.27	(a)	3.73	3.57	.....	.....
Wisconsin	4.06	2.56	.....	.....	.....	.....
Other States [b]	1.50	1.94	6.48	1.75	7.46	5.04
	4.09	3.37	4.19	2.63	4.59	3.61

[a] Less than three producers and permission to publish not given, therefore price may not be shown.
[b] 1920: Arizona, Colorado, Connecticut, Idaho, Maryland, Massachusetts, Nevada, Washington, and Wyoming; 1921: Colorado, Idaho, Maryland, Massachusetts, Missouri, North Carolina, Tennessee, Texas, Utah, and Wyoming.

Average price per gross ton of iron ore in the United States, 1906–1921.

Year.	Hematite.	Brown ore.	Magnetite.	Carbonate.	General average.[a]
1906	$2.13	$1.78	$2.05	$1.75	$2.11
1907	2.03	1.81	2.03	1.74	2.55
1908	2.32	1.70	2.40	1.38	2.27
1909	2.17	1.68	2.40	1.73	2.15
1910	2.52	1.76	2.36	1.61	2.47
1911	2.12	1.72	2.29	1.83	2.11
1912	1.87	1.79	2.18	1.96	1.88
1913	2.21	1.88	2.07	2.06	2.19
1914	1.79	1.72	2.39	2.44	1.81
1915	1.80	1.80	2.50	2.44	1.83
1916	2.32	2.03	3.11	3.00	2.34
1917	3.12	2.95	4.29	.....	3.15
1918	3.35	3.51	4.60	.....	3.39
1919	3.48	3.63	4.08	.....	3.50
1920	4.09	4.19	4.59	(*b*)	4.11
1921	3.37	2.63	3.61	(*b*)	3.37

[a] Average prices in 1889 and 1892–1905 are given in Mineral Resources for 1919 and many earlier volumes.
[b] Sold for paint and not included in shipments.

LAKE SUPERIOR DISTRICT.

PRODUCTION.

The total quantity of ore mined in the Lake Superior district, not including the Iron Ridge area in Wisconsin, decreased 56 per cent in 1921. The output of the several ranges is shown below. All ore containing more than 5 per cent of manganese is excluded. The production of manganiferous iron ore from the Cuyuna range is reported in the chapter on manganese and manganiferous ores in this volume of Mineral Resources. The Mesabi range produced 65 per cent of the output of the Lake Superior district and 56 per cent of the output of the United States.

Iron ore mined in the Lake Superior district, 1854–1921, in gross tons.

Year.	Marquette.	Menominee.	Gogebic.	Vermilion.	Mesabi.	Cuyuna.	Total.
1854–1870	3,971,716	.....	.....	.....	.....	.....	3,971,716
1871–1880	10,294,047	858,810	.....	.....	.....	.....	11,152,857
1881–1890	18,598,012	11,917,416	8,657,807	3,260,426	.....	.....	42,433,661
1891–1900	27,269,545	21,639,872	23,361,043	12,097,048	32,282,873	.....	116,650,381
1901–1910	37,728,143	41,974,789	34,514,899	15,350,581	194,654,902	.....	324,223,314
1911	3,743,145	4,062,778	3,099,197	1,336,938	23,126,943	181,224	35,550,225
1912	3,545,012	4,465,466	3,926,632	1,457,273	32,604,756	369,739	46,368,878
1913	3,977,808	4,997,246	4,743,515	1,536,115	36,378,671	744,007	52,377,362
1914	3,320,763	3,671,499	4,601,240	1,362,416	19,808,434	776,051	33,540,403
1915	3,817,892	4,665,465	4,996,237	1,541,645	30,802,409	1,120,606	46,944,254
1916	4,792,987	6,649,578	7,707,101	1,704,440	41,325,341	1,555,641	63,735,088
1917	4,638,374	6,366,483	7,881,232	1,481,301	41,127,323	1,986,608	63,481,321
1918	3,946,554	6,041,637	7,837,634	1,192,677	39,055,977	1,705,315	59,779,794
1919	4,158,751	4,863,968	7,368,994	1,051,795	33,262,954	1,685,877	52,392,339
1920	4,457,609	5,651,542	8,298,206	1,053,518	36,641,880	1,757,775	57,860,530
1921	2,204,114	2,147,569	3,135,477	981,576	16,380,190	449,559	25,298,485
	140,464,472	129,974,118	130,129,214	45,407,749	577,452,653	12,332,402	1,035,760,608

SHIPMENTS AND RECEIPTS.

According to the Iron Trade Review, 22,798,349 gross tons of iron ore and manganiferous iron ore was shipped in 1921 from the Lake Superior district, including the Iron Ridge and Baraboo areas in Wisconsin, as compared with 60,411,572 tons in 1920. The shipments as reported to the Geological Survey in 1921 amounted to 22,778,162

gross tons, exclusive of manganiferous iron ore containing 5 per cent or more of manganese, compared with 59,677,331 tons in 1920.

The iron ore received at Lake Erie ports in 1921 amounted to 15,830,457 gross tons and at Lake Michigan ports to 5,838,678 gross tons, a total of 21,669,135 tons, compared with 45,669,994 tons at Lake Erie ports and 11,393,184 tons at Lake Michigan ports, a total of 57,063,178 tons, in 1920. Detailed figures of shipments and receipts by ports and by months will be found in issues of the Iron Trade Review and, for 1919 and preceding years, in Mineral Resources.

STOCKS OF IRON ORE AT LAKE ERIE PORTS.

Stocks of iron ore at lower Lake ports at the end of the shipping season are of importance on account of their bearing on the manufacture of pig iron during the following winter and spring. At the close of navigation in 1921 there was 9,096,909 gross tons of ore in stock at Lake Erie ports, compared with 10,930,854 tons at the corresponding date in 1920.[5] At the opening of navigation in May, 1922, there was 6,988,878 gross tons of ore in stock at these ports,[6] indicating a withdrawal of more than 2,000,000 tons during the winter of 1921–22. The average quantity withdrawn each winter during the preceding five winters was nearly 4,390,000 tons. Detailed statistics concerning these stocks by ports will be found in the Iron Trade Review and Marine Review and, for 1919 and preceding years, in Mineral Resources.

PRICES OF LAKE SUPERIOR IRON ORE.

The value of iron ore per unit of iron, in the natural state, for the four standard grades of Lake Superior ore for the last 22 years is shown in the Iron Trade Review.[7] The values established June 16, 1921, are as follows: Old range Bessemer, 12.818 cents; Mesabi Bessemer, 12.364 cents; old range non-Bessemer, 12.233 cents; Mesabi non-Bessemer, 11.942 cents. The prices per ton that correspond to these unit prices are, respectively, $6.45, $6.20, $5.70, and $5.55, and are $1 lower than the prices prevailing during the shipping season of 1920. The base for old range and Mesabi Bessemer ore is a metallic iron content of 55 per cent, natural, and for the old range and Mesabi non-Bessemer 51.5 per cent, natural. The prices in 1920 are the highest on record. The lowest prices ever quoted for these ores were $2.60 for old range Bessemer in 1897, $2.15 for Mesabi Bessemer in 1895, $1.85 for old range non-Bessemer in 1898, and $1.75 for Mesabi non-Bessemer ore in 1898.

MINING DEVELOPMENTS.

The reduction in demand for iron ore at all producing centers naturally retarded mining developments, and there were few features of outstanding importance during 1921, although progress was made in work that was well under way in 1920. More extended reviews will be found in the technical press.[8]

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[5] Iron Trade Review.
[6] Marine Review.
[7] Iron Trade Review, June 15, 1922, p. 1743.
[8] See Iron Trade Review, Jan. 5, 1922, and Iron Age, Jan. 5 and Jan. 12, 1922.

LAKE SUPERIOR DISTRICT.

The use of small steam shovels traveling on caterpillar tractors having proved successful in the Lake Superior district, experiments are being carried on to equip the larger shovels with caterpillars. The use of electrically driven shovels is increasing. Electrification of mine equipment on the Marquette and Menominee ranges showed progress in 1921. New records were made in loading and unloading iron ore on Lake vessels. Iron ore was shipped by barge from St. Paul, Minn., to St. Louis, Mo., and it is planned to extend this mode of transportation by way of Mississippi River in 1922. A decreased rail rate has been established from the Cuyuna range to St. Louis, Mo., and thus there promises to be competition in this respect which may result in a larger output of pig iron in the St. Louis district. In this connection it might be stated that operations of one of the charcoal iron manufacturers in southeastern Missouri are reported to have been discontinued in 1921 owing to the depletion of supplies of wood and local iron ore.

Although operations at many mines on the Cuyuna range were discontinued, the use of manganiferous iron ore from this district is increasing and promises to create a good demand for ore of this character. Reports of discoveries of bodies of high-grade iron ore indicate that the possibilities of this range are not yet fully known.

Construction of the plant for concentration of lean magnetite ore at Babbitt, Minn., in the eastern part of the Mesabi range, was considerably advanced during 1921, and it is expected that commercial shipments of sintered concentrates will be made in 1922. The Minnesota School of Mines Experiment Station, having already pointed the way by experimental work toward the commercial concentration of lean magnetite ore, gave during 1921 attention to the possibility of preparing low-grade hematite for magnetic separation. The hematite is first roasted with suitable fuel under reducing conditions, and the general principles of the subsequent treatment are similar to those employed with the low-grade magnetite.[9] The reserves of low-grade ore in the Lake Superior district that may ultimately be made available through the application of these processes are surprisingly great and seem to be limited only by the minimum percentage of iron in the raw material which it will pay to handle.

Stocks of iron ore increased about 21 per cent in the Lake Superior district in 1921 as compared with those of 1920, making approximately 4,235,000 tons on hand at the end of the year at mines in Minnesota and approximately 7,879,000 tons in Michigan. This large increase in stocks of ore is a testimonial to the liberal policy of the mining companies in providing work in excess of what was necessary to supply the demand for ore in order to support their mining organizations.

Estimates of ore reserves for Minnesota, furnished by Rukard Hurd, director of mines of the Minnesota Tax Commision, and for Michigan, furnished by R. A. Smith, State geologist, including developed and prospective ore in the ground and ore in stock piles, show a decrease of nearly 30,300,000 gross tons in Minnesota and nearly 2,500,000 tons in Michigan. The Vermilion and Cuyuna ranges in Minnesota and the Marquette range in Michigan each showed increases in 1921.

[9] An outline of this process of magnetic concentrating is publis hed in the chapter on iron ore, pig iron, and steel in Mineral Resources for 1920, pp. 375–376.

Iron-ore reserves in Minnesota May 1, 1918, 1919, 1920, and 1921, in gross tons.

Range.	1918	1919	1920	1921
Mesabi	1,362,277,471	1,328,821,214	1,305,926,735	1,273,128,664
Vermilion	12,251,025	11,621,197	10,927,844	13,201,525
Cuyuna	63,208,588	59,393,443	24,819,959	25,080,590
	1,437,737,084	1,399,835,854	1,341,674,538	1,311,410,779

Iron-ore reserves in Michigan Jan. 1, 1919, 1920, 1921, and 1922, in gross tons.

Range.	1919	1920	1921	1922
Gogebic	63,497,143	64,563,003	64,964,666	63,356,146
Marquette	75,819,940	70,114,034	73,853,786	73,933,551
Menominee (including Iron River and Crystal Falls districts)	64,254,626	63,929,438	65,311,868	64,386,025
	203,571,709	198,606,475	204,130,320	201,675,722

SOUTHEASTERN STATES.

Almost complete stagnation characterized the iron-ore mining districts in Virginia, North Carolina, Tennessee, and Georgia during 1921, and only about one-half the normal activity prevailed at Birmingham, the chief iron center in Alabama. In Shades Valley, in the Birmingham district, the "big seam" of bedded hematite was tapped for the first time in 1920 by a deep incline and by a vertical shaft. Ore was mined in 1921 from the incline, but the shaft was for some reason not used and was allowed to fill with water. Shaft mining, which was expected soon to play an important part in the extraction of ore in this district, seems destined to be postponed for an indefinite period. A great deal of money has been invested in slope-mining equipment and in railroads connecting the slope mines with the blast furnaces, and as much of this equipment would be rendered useless if new shaft mines were opened it is probable that the present system will be continued by most of the companies as long as it is practicable. Furthermore, the presence of faults, which tend to complicate mining below Shades Valley, has been reported as a result of late developments, and it is understood that the shale roof above the ore has been found unsatisfactory in some places at great depth.

In connection with studies of concentration of low-grade hematite in the Lake Superior district, it seems that the time is nearly at hand when similar studies could advantageously be undertaken of the siliceous and aluminous red and brown hematites of the Birmingham and other southeastern districts. It was pointed out by the Geological Survey [10] in 1910 that there are in the Birmingham and neighboring districts large reserves of hematite that are just below commercial grade, which under the present system of mining are irretrievably lost but which, if they could be concentrated and thereby saved, would prolong the life of the district. The conservation of this ore, much of which is in the lower bench of the "big seam" near Birmingham, would incidentally extend the period of operation of the present slope mines.

[10] Burchard, E. F., and Butts, Charles, Iron ores, fuels, and fluxes of the Birmingham district, Ala.: U. S. Geol. Survey Bull. 400, 1910.

FOREIGN TRADE IN IRON ORE.

IMPORTS.

The iron ore imported into the United States in 1921 decreased 75 per cent in quantity and 78 per cent in value, as compared with the imports in 1920. The average value was $3.41 a ton in 1921 and $3.90 in 1920. Sweden contributed 45 per cent of the ore imported, Cuba 39 per cent, and Morocco nearly 5 per cent. The large increase in imports from Sweden is noteworthy. The accompanying diagram (fig. 12) indicates the source and district of entry of the iron ore imported into the United States.

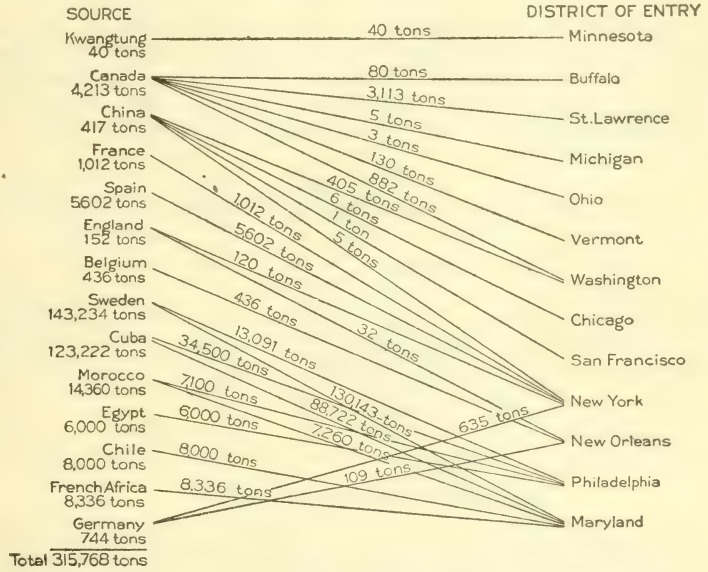

FIGURE 12.—Source and district of entry of iron ore imported into the United States in 1921.

Iron ore imported into the United States, 1919–1921.

Country.	1919		1920		1921	
	Gross tons.	Value.	Gross tons.	Value.	Gross tons.	Value.
Belgium					436	$1,814
Brazil	10	$20				
British India			2,812	$25,133		
British West Africa	3,981	26,000				
Canada	12,383	64,785	34,084	164,158	4,213	15,667
Chile					8,000	30,000
China			2	18	417	19,169
Colombia			11,649	46,596		
Cuba	321,753	1,221,949	889,852	3,488,682	123,222	493,092
Egypt					6,000	17,922
France	6,376	57,000			1,012	4,935
French Africa			158,879	462,222	8,336	25,304
Germany			1	14	744	4,023
Hungary			4,380	8,710		
Kwangtung			1	21	40	218
Mexico	75	392	124	982		
Morocco			34,950	165,246	14,360	57,912
Norway	6,426	35,000	1,828	8,228		
Panama			802	4,532		
Philippine Islands			1	[a] 250		
Spain	63,737	592,096	69,915	241,640	5,602	17,427
Sweden	61,540	384,067	63,861	340,519	143,234	384,283
United Kingdom	180	4,380	315	6,703	152	4,143
	476,461	2,385,689	1,273,456	4,963,654	315,768	1,075,909

[a] Correct as reported by collector of customs, San Francisco, Calif.

Iron ore imported into the United States, 1872–1921, in gross tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1872–1880	1,188,267	1913	2,594,770	1919	476,461
1881–1890	7,663,630	1914	1,350,588	1920	1,273,456
1891–1900	5,869,757	1915	1,341,281	1921	315,768
1901–1910	11,798,568	1916	1,325,736		
1911	1,811,732	1917	971,663		40,873,721
1912	2,104,576	1918	787,468		

EXPORTS.

The iron ore exported from the United States in 1921 was valued at $2,077,620, or $4.72 a ton, as compared with $6,198,927, or $5.41 a ton, in 1920. The exports represent a decrease of 62 per cent in quantity and 66 per cent in value, as compared with 1920. With the exception of a small quantity to Mexico, all the ore exported in 1921 went to Canada.

Iron ore exported from the United States, 1899–1921, in gross tons.

Year.	Quantity.	Year.	Quantity.
1899–1900	92,125	1917	1,132,313
1901–1910	2,713,397	1918	1,256,383
1911	768,386	1919	996,569
1912	1,195,742	1920	1,145,037
1913	1,042,151	1921	440,106
1914	551,618		
1915	707,641		13,225,420
1916	1,183,952		

IRON-ORE MINING IN CUBA.

The iron ore shipped from Cuba to the United States in 1921 was valued at $477,002, compared with $3,232,851 in 1920, and showed decreases in quantity and value of 85 per cent each. The average price of the ore was $3.66 a ton in 1921 and 1920. The shipments in 1921 consisted of hematite and a little magnetite from the Daiquiri and Juragua mines, on the southern coast. The Mayari mines, near the northern coast, were nonproductive in 1921. In 1921 the iron content of the hematite, dried at 212° F., was reported at 57.37 per cent; in 1920 it averaged 57.26 per cent.

The total stock of ore (natural and nodulized) reported as on hand at the end of 1921 was 941,939 gross tons, compared with 691,168 tons at the end of 1920, an increase of 36 per cent.

The following table shows the shipments of iron ore from Cuba since the opening of the mines in 1884. The statistics of the shipments of Cuban iron ore are collected by the United States Geological Survey.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1921, in gross tons.

Year.	Juragua (hematite and magnetite).	Sigua (hematite).	Daiquiri (hematite and a little magnetite).	Mayarí (brown ore).	Guamá (hematite).	El Cuero (hematite).	Total.
1884–1890	1,142,519	.....	.....	.....	.....	.....	1,142,519
1891–1900	[a] 2,348,473	20,438	[b] 979,992	.....	.....	.....	3,348,903
1901–1910	2,104,186	.....	[c] 4,456,440	307,700	41,241	224,729	7,134,296
1911	355,132	.....	252,717	387,791	.....	168,074	1,163,714
1912	360,094	.....	463,533	446,176	.....	127,994	1,397,797
1913	369,213	.....	591,322	491,713	.....	130,183	1,582,431
1914	267,641	.....	284,507	228,949	.....	40,013	821,110
1915	215,032	.....	245,590	300,896	.....	65,930	827,448
1916	212,013	.....	181,602	258,451	.....	60,650	712,716
1917	39,784	.....	181,028	287,904	.....	44,769	553,485
1918	17,128	.....	353,103	232,540	.....	40,761	643,532
1919	.....	.....	279,700	78,080	.....	.....	357,780
1920	(*d*)	.....	[d] 561,268	321,515	.....	.....	882,783
1921	(*d*)	.....	[d] 130,359	.....	.....	.....	130,359
	[d] 7,431,215	20,438	[d] 8,961,161	3,341,715	41,241	903,103	20,698,873

[a] Of this quantity, 5,932 tons was sent to Pictou, Nova Scotia.
[b] Of this quantity, 51,537 tons was sent to foreign ports.
[c] Of this quantity, 12,691 tons was sent to foreign ports.
[d] Shipments in 1920 and 1921 of Juragua mines included with Daiquiri mines.

PRODUCTION OF IRON ORE, BY COUNTRIES.

The following table of production of iron ore by countries is far from complete, as it has not been possible to obtain certain figures for 1917 and later years. (For additional data see pp. 513–564.)

Iron ore produced, by countries, 1913 and 1917–1921, in metric tons.

Country.	1913	1917	1918	1919	1920	1921	Source of data.[a]
North America:							
Canada [b]	279,084	195,317	191,967	178,869	117,092	53,894	1913–1921, 1.
Cuba [b]	1,607,750	562,341	653,829	363,522	896,952	132,451	1913–1921, 2.
Newfoundland [b]	1,456,859	801,172	769,809	453,565	590,850	(d)	1913–1920, 1.
United States	62,972,124	76,493,473	70,772,810	61,943,913	68,689,517	29,964,308	1913–1921, 2.
South America:							
Chile	14,100	5,000	2,743	.....	.....	48,393	1913–1917, 3; 1918–1921, 2.
Venezuela [c]	58,141	.....	.....	.....	.....	.....	1913, 4.
Europe:							
Austria	3,039,324	1,757,654	1,162,198	250,520	435,085	710,932	1913, 5; 1917–18, 6; 1919–20, 7; 1921, 27.
Belgium	150,450	17,000	500	4,820	17,260	38,300	1913–1920, 8; 1921, 7.
Bosnia-Herzegovina	220,069	406,323	(d)	(d)	(d)	(d)	1913–1917, 6.
France	21,917,870	2,034,721	1,671,851	e9,412,786	e 13,921,800	e 14,116,706	1913–1920, 9; 1921, 10.
Germany	e28,607,903	e22,464,780	e18,392,569	6,153,834	(d)	(d)	1913–1917, 11; 1918, 11 and 12; 1919, 13.
Greece	313,578	63,364	67,871	46,939	44,751	31,880	1913–1917, 14; 1918, 6; 1919–21, 7.
Hungary	2,059,076	1,581,121	(d)	112,525	101,665	(d)	1913–1917, 15; 1919–20, 16.
Italy	603,116	993,825	693,872	613,025	389,876	279,980	1913–1920, 17; 1921, 36.
Luxemburg	7,333,382	4,502,692	3,131,400	3,112,472	f 3,704,390	(d)	1913–1917, 11; 1918, 12; 1919–20, 7.
Norway	544,686	302,739	95,887	89,765	79,208	(d)	1913–1920, 18.
Poland	(f)	(f)	(f)	92,725	120,824	230,000	1919–1921, 15.
Portugal	49,182	7,381	.....	8,712	12,845	10,370	1913, 19; 1917–18, 6; 1919–21, 7.
Rumania	(d)	(d)	(d)	43,945	43,202	(d)	1919–20, 7.
Russia	9,513,945	(d)	(d)	(d)	(d)	(d)	1913, 20.
Spain	9,861,668	5,551,071	4,692,651	4,640,061	4,767,693	2,602,369	1913–1920, 21; 1921, 7.
Sweden	7,475,571	6,217,172	6,623,661	4,981,110	4,519,112	6,464,347	1913–1920, 22; 1921, 37.
United Kingdom	16,254,085	15,084,008	14,847,571	12,450,875	12,910,840	(d)	1913–1920, 23.
Asia:							
China	g423,003	304,356	c382,719	1,338,874	1,489,731	(d)	1913, 24; 1917, 19; 1918, 6; 1919–20, 7.
Chosen	142,012	140,613	202,882	423,267	454,427	(d)	1913, 4; 1917, 6; 1918–19, 25; 1920, 7.
India	376,797	419,991	500,607	572,798	566,961	610,000	1913–1920, 26; 1921, 27.
Indo-China	.....	.....	.....	5,100	(d)	(d)	1913–1919, 9.
Japan	171,656	(d)	232,436	204,846	203,559	(d)	1913, 4; 1918–1920, 28.
Unfederated Malay States	.....	.....	.....	.....	.....	75,442	1921, 7.
Africa:							
Algeria	1,348,899	985,293	902,465	738,376	1,096,840	708,043	1913–1919, 9; 1920–21, 7.
Belgian Kongo	(d)	(d)	(d)	85,000	79,732	73,215	1919–1921, 29.
Rhodesia	.....	4,799	5,765	2,268	.....	(d)	1917–1920, 30.
Tunis	597,500	605,958	421,543	308,135	406,280	262,736	1913–1919, 9; 1920–21, 7.
Union of South Africa	.....	.....	4,426	3,268	2,326	2,192	1913–1920, 31; 1921, 7.
Oceania:							
Australia—							
New South Wales [h]	75,981	97,840	120,548	149,135	165,820	181,839	1913–1921, 32.
Queensland	41,031	25,467	43,469	25,072	20,025	4,126	1913–1921, 33.
South Australia	61,632	333,657	261,154	272,840	419,667	515,130	1913–1921, 34.
Philippine Islands	(d)	(d)	(d)	18,598	(d)	(d)	1919, 35.

[a] 1, Canada Dept. Mines, Mines Branch; 2, U. S. Geol. Survey; 3, Anuario estadístico de la República de Chile; 4, Bur. Foreign and Domestic Commerce; 5, Oesterreichisches statistisches Handbuch; 6, Imperial Mineral Resources Bureau, London; 7, official preliminary; 8, Statistique des industries extractives et métallurgiques; 9, Statistique de l'industrie minérale; 10, Annales des mines; 11, Vierteljahrshefte zur Statistik; 12, Comité central des houillères de France, No. 5532; 13, Statistisches Reichsamt; 14, Tableau statistique de mouvement minier; 15, Montanistiche Rundschau; 16, Bureau of Mines, Ministry of Finance, and American Commission; 17, Rivista del servizio minerario; 18, Norges offisielle Statistikk; 19, National Federation of Iron and Steel Manufacturers (London); 20, Russian Dept. Mining and Metallurgical Industries; 21, Estadística minera de España; 22, Bergshantering Sveriges officiella Statistik; 23, Mines and Quarries (London); 24, Iron Trade Review; 25, official data furnished by American consul general, Keijo (Seoul), Chosen, and American embassy, Tokyo, Japan; 26, Records Geol. Survey of India; 27, Min. Jour.; 28, Mining industry of Japan; 29, Ann. Rept. Union minière du Haut Katanga; 30, Rept. Secretary for Mines; 31, Ann. Rept. Dept. Mines and Industries; 32, Ann. Repts. Dept. Mines; 33, Ann. Repts. Under Secretary for Mines; 34, Review of mining operations, Dept. Mines; 35, Mineral resources of the Philippine Islands; 36, Commerce Reports; 37, Iron Age.

[b] Shipments.

[c] Exports.

[d] No figures available.

[e] Includes Lorraine.

[f] Included with Austria and Russia.

[g] From Tayeh deposit.

[h] Includes iron ore from State mines received at Eskbank iron works, Lithgow, also ironstone for flux and iron oxide.

BENEFICIATED IRON ORE.

The processes reported as employed in 1921 to improve the quality of the ore at mines were crushing and screening, drying by direct heat and by steam, hand picking on tables and on belts, washing by means of hydraulic jets and logs, jigging, electromagnetic cobbing, other concentration and separation, calcining, nodulizing, and desulphurization by sintering. Some of the operations combined two or more of these processes. Iron ores were reported as beneficiated at 59 mines in 12 States in 1921 and at 98 mines in 13 States in 1920. Some iron ore is also recovered in the form of blast-furnace ore dust, but no statistics have been gathered on this subject. Ore so recovered has been originally accounted for in the statistics of shipments from the mines.

The total beneficiated ore reported as shipped from mines in the United States in 1921 decreased 56 per cent in quantity and 65 per cent in value, as compared with 1920. From such figures as are available, showing the relation between crude ore treated and beneficiated ore recovered, it is apparent that in washing brown ore the ratios, by weight, of crude ore washed to resultant concentrates range from 6:1 to 1.25:1; in concentrating hematite the ratios range from 2.987:1 to 1.111:1; in magnetite they range from 3.456:1 to 1.077:1; and in carbonate the ratio is 1.333:1.

Beneficiated iron ore shipped from mines in the United States, 1920 and 1921.

State.	Variety.	1920		1921	
		Gross tons.	Value.	Gross tons.	Value.
Alabama	Hematite, brown ore	1,073,770	$4,167,240	327,792	$834,431
Georgia	Brown ore	61,172	287,315	(a)	(a)
Michigan	Hematite	164,552	671,475		
Minnesota	do	5,050,968	20,432,601	2,936,085	9,968,425
New Jersey	Magnetite, brown ore	417,100	2,595,949	115,132	551,688
New York	Magnetite	803,492	5,266,728	159,088	856,390
North Carolina	Magnetite, brown ore	27,058	110,075	(a)	(a)
Pennsylvania	do	502,984	2,193,343	101,129	493,482
Tennessee	Hematite, brown ore	266,776	1,015,956	21,001	59,236
Virginia	do	126,234	476,501	45,206	156,501
Other States b	do	20,732	134,015	22,188	88,237
		8,514,838	37,351,198	3,727,621	13,008,390

a Included under "Other States."
b 1920: Connecticut, Maryland, Massachusetts, and Missouri; 1921: Georgia, Maryland, Massachusetts, Missouri, New Mexico, and North Carolina.

IRON AND STEEL.

The records of the production and sales of iron and steel shown in the following pages are derived in part from producers who report directly to the United States Geological Survey and in part from several other authoritative sources, such as the American Iron and Steel Institute, Metal Statistics, the Iron Age, the Iron Trade Review, and the Bureau of Foreign and Domestic Commerce of the Department of Commerce.

PIG IRON.

SHIPMENTS, VALUE, AND PRODUCTION, BY STATES.

According to reports to the United States Geological Survey by the manufacturers, the shipments of pig iron, exclusive of ferroalloys, in 1921 decreased 55 per cent in quantity and 66 per cent in gross value

as compared with 1920. The values stated represent the approximate amounts received for the iron f. o. b. furnaces and do not include freight costs, selling commissions, and other items which are figured in some of the market prices of pig iron as published in the trade journals.

The pig iron shipped includes the metal produced from foreign as well as from domestic ore. The pig iron derived from ore imported from Algeria, Canada, Chile, Cuba, Spain, and Sweden, although it constitutes a very small percentage of the total production, amounted in 1921 to 165,620 gross tons, valued at $4,166,656, as compared with 599,537 tons, valued at $24,668,410, in 1920. In the manufacture in 1921 of 231,514 gross tons of pig iron, 387,131 gross tons of foreign iron ore, including 15,093 tons of cinder derived from foreign pyrite, was reported to have been used, thus indicating an average pig-iron yield of 59.80 per cent from imported ore. Domestic ore, including 2,254,771 gross tons of cinder, scale, and scrap and amounting to 31,102,166 gross tons, was reported in 1921 as used in the manufacture of 16,172,113 tons of pig iron, thus indicating a yield of 52 per cent in pig iron from domestic materials. The total production in 1921 of pig iron, exclusive of ferroalloys, reported to the Geological Survey was 16,403,627 gross tons.

Pig iron shipped from blast furnaces in the United States, 1920 and 1921, by States.

State.	1920		1921					
					Decrease.		Percentage of decrease.	
	Gross tons.	Value.	Gross tons.	Value.	Gross tons.	Value.	Quantity.	Value.
Alabama	2,339,939	$76,520,797	1,241,227	$30,195,978	1,098,712	$46,324,819	47	61
Illinois	3,238,814	90,736,015	1,490,638	36,513,263	1,748,176	54,222,752	54	60
Indiana	2,418,048	61,852,856	1,655,275	36,945,411	762,773	24,907,445	32	40
Kentucky	230,316	7,306,711	28,375	816,372	201,941	6,490,339	88	89
Michigan	464,197	16,812,062	200,944	5,955,205	263,253	10,856,857	57	65
Missouri	81,682	3,678,623	17,028	479,957	64,654	3,198,666	79	87
New Jersey	88,408	3,380,145	(a)	(a)	(a)	(a)	(a)	(a)
New York	2,415,627	89,416,703	786,713	18,212,810	1,628,914	71,203,893	67	80
Ohio	8,229,770	246,326,276	3,649,835	88,473,082	4,579,935	157,853,194	56	64
Pennsylvania	13,472,814	448,251,415	6,072,196	148,350,285	7,400,618	299,901,130	55	67
Tennessee	217,887	9,271,324	21,972	595,850	195,915	8,675,474	90	94
Virginia	390,372	16,086,946	66,916	2,023,268	323,456	14,063,678	83	87
West Virginia	489,689	15,927,822	259,312	6,557,498	230,377	9,370,324	47	59
Wisconsin	363,588	12,355,028	93,666	2,730,155	269,922	9,624,873	74	78
Other States [b]	1,269,076	42,981,373	454,522	11,588,658	902,962	34,772,860	67	75
	35,710,227	1,140,904,096	16,038,619	389,437,792	19,671,608	751,466,304	55	66

[a] Included under "Other States."
[b] 1920: Colorado, Connecticut, Maryland, Massachusetts, and Minnesota; 1921: Colorado, Connecticut, Maryland, Massachusetts, Minnesota, and New Jersey.

Pig iron shipped from blast furnaces in the United States in 1920 and 1921, by grades.

Grade.	1920			1921		
	Gross tons.	Value.	Average price.	Gross tons.	Value.	Average price.
Charcoal	301,185	$12,730,135	$42.27	79,727	$2,964,106	$37.18
Foundry	5,195,470	193,186,411	37.18	2,285,554	58,711,067	25.69
Basic	16,639,716	499,089,466	29.99	7,755,612	179,355,963	23.13
Bessemer	11,627,398	362,816,613	31.20	5,345,646	133,181,663	24.91
Low phosphorus	368,268	16,279,819	44.21	74,517	2,759,054	37.03
Malleable	1,210,853	42,973,332	35.49	325,901	8,179,596	25.10
Forge	304,197	11,327,920	37.24	128,062	3,182,081	24.85
All other (not ferroalloys)	63,146	2,500,400	39.60	43,600	1,104,262	25.33
	35,710,227	1,140,904,096	31.95	16,038,619	389,437,792	24.28

The American Iron and Steel Institute reports that the output in 1921 of all kinds of pig iron, including ferroalloys, produced in blast furnaces, as well as some that was electrically produced, decreased 20,237,801 tons, or 55 per cent, as compared with 1920.

Pig iron, including ferroalloys, manufactured in the United States in 1920 and 1921, in gross tons.[a]

State.	1920	1921	State.	1920	1921
Pennsylvania	13,983,134	6,252,766	Missouri, Iowa, Colorado, Montana, Washington	464,584	226,364
Ohio	8,533,470	3,799,613			
Illinois	3,280,875	1,612,033			
Alabama	2,392,962	1,207,408			
Indiana, Michigan	2,939,521	1,893,611	Maryland	523,733	147,189
New York, New Jersey	2,601,134	968,660	Tennessee	283,207	19,479
Wisconsin, Minnesota	711,405	226,863	Connecticut, Massachusetts, Maine	10,281	2,142
West Virginia, Kentucky	772,379	264,759			
Virginia	429,302	67,239		36,925,987	16,688,126

[a] American Iron and Steel Institute.

AVERAGE PRICES.

AT BLAST FURNACES.

The average price of all kinds of pig iron given in the following table is based on reports of the manufacturers to the Geological Survey. The figures represent the approximate prices f. o. b. at the blast furnaces and do not include the prices of ferroalloys. The general average price for all grades of pig iron at the furnaces, exclusive of ferroalloys, showed a decrease of 24 per cent for 1921.

Average price per gross ton of pig iron in the United States, 1916–1921.

State.	1916	1917	1918	1919	1920	1921
Alabama	$14.59	$21.64	$30.58	$25.96	$32.70	$24.33
Illinois	17.57	26.34	30.91	24.42	28.02	24.50
Indiana	(a)	(a)	29.09	22.51	25.58	22.32
Kentucky	17.97	28.78	34.19	30.06	31.72	28.77
Michigan	17.51	29.93	35.44	32.23	36.22	29.64
Missouri	(a)	(a)	36.97	33.40	45.04	28.19
New Jersey	(a)	35.25	34.22	31.48	38.23	(a)
New York	17.70	22.98	28.27	26.84	37.02	23.15
Ohio	15.75	27.30	30.31	25.59	29.93	24.24
Pennsylvania	17.95	29.87	31.69	25.86	33.27	24.43
Tennessee	15.13	26.26	34.08	33.10	42.55	27.12
Virginia	16.06	27.93	34.00	31.53	41.21	30.24
West Virginia	(a)	(a)	(a)	25.04	32.53	25.29
Wisconsin	17.77	27.39	38.08	29.42	33.98	29.15
Other States [b]	16.03	24.25	28.52	25.92	33.87	25.50
Average for United States	16.96	27.29	30.89	25.75	31.95	24.28

[a] Included under "Other States."

[b] 1916: California, Colorado, Connecticut, Indiana, Maryland, Massachusetts, Minnesota, Missouri, New Jersey, and West Virginia; 1917: Colorado, Connecticut, Georgia, Indiana, Maryland, Massachusetts, Minnesota, Missouri, Washington, and West Virginia; 1918: Colorado, Connecticut, Georgia, Maryland, Massachusetts, Minnesota, Washington, and West Virginia; 1919: Colorado, Connecticut, Maryland, Massachusetts, Minnesota, Texas, and Washington; 1920: Colorado, Connecticut, Maryland, Massachusetts, and Minnesota; 1921: Colorado, Connecticut, Maryland, Massachusetts, Minnesota, and New Jersey.

Average price per gross ton of pig iron in the United States, 1889–1921.

1889	$15.78	1900	$18.85	1911	$14.07
1890	16.43	1901	15.25	1912	13.93
1891	15.50	1902	20.92	1913	15.08
1892	14.32	1903	19.12	1914	13.42
1893	11.90	1904	14.13	1915	13.21
1894	9.76	1905	16.63	1916	16.96
1895	11.14	1906	19.98	1917	27.29
1896	10.47	1907	20.56	1918	30.89
1897	9.85	1908	15.96	1919	25.75
1898	9.90	1909	16.25	1920	31.95
1899	18.00	1910	15.45	1921	24.28

COMMERCIAL QUOTATIONS.

The average monthly prices of the principal grades of pig iron either at the blast furnaces or at the nearest market in 1920 and 1921, according to published market quotations, are summarized in the following table for comparison with figures reported by blast-furnace operators as shown in preceding tables, and the commercial quotations during the last few years, which include the war period, are shown graphically in figure 13. The contrasts are marked between the moderate prices up to the end of 1916; the unregulated, extremely high prices at the middle of 1917; the even prices as regulated by the Government from October, 1917, to the end of 1918; the natural downward trend until October, 1919; the rapidly mounting price during the next year; and finally the rapid decline, beginning with September, 1920, and ending in August, 1921, which brought the price down to about the level of that of the summer of 1916.

Average monthly prices per ton of principal grades of pig iron, 1920 and 1921.[a]

Month.	Foundry pig iron at Valley furnaces.		Foundry pig iron at Birmingham furnaces.		Bessemer pig iron at Valley furnaces.		Basic pig iron at Valley furnaces.	
	1920	1921	1920	1921	1920	1921	1920	1921
January	$38.46	$31.92	$37.77	$31.14	$37.65	$32.00	$36.62	$30.00
February	41.00	28.29	40.00	27.50	41.67	29.63	42.13	27.71
March	42.00	25.89	40.00	25.52	42.00	26.70	41.50	24.41
April	42.42	24.81	40.00	23.77	42.21	25.00	42.13	23.00
May	43.96	23.60	42.00	21.80	42.54	24.32	43.12	22.15
June	45.60	22.42	42.00	20.48	43.23	22.88	43.62	21.20
July	45.15	20.40	42.00	20.18	45.58	21.34	45.42	19.52
August	47.85	19.59	42.00	18.70	47.35	20.00	46.96	18.22
September	50.00	20.86	42.00	19.06	48.50	20.00	48.50	19.00
October	46.62	21.00	42.00	19.00	47.67	20.00	44.00	19.24
November	40.72	20.78	39.02	18.56	40.84	20.00	37.62	19.00
December	35.77	20.00	36.42	17.31	35.00	20.00	33.00	19.00
Average	43.25	23.30	40.43	21.92	42.85	23.49	42.05	21.87

[a] Metal Statistics, 1922.

DAILY AVERAGE PRODUCTION.

The daily average production of coke and anthracite pig iron by months during the last six years is graphically illustrated in figure 14.

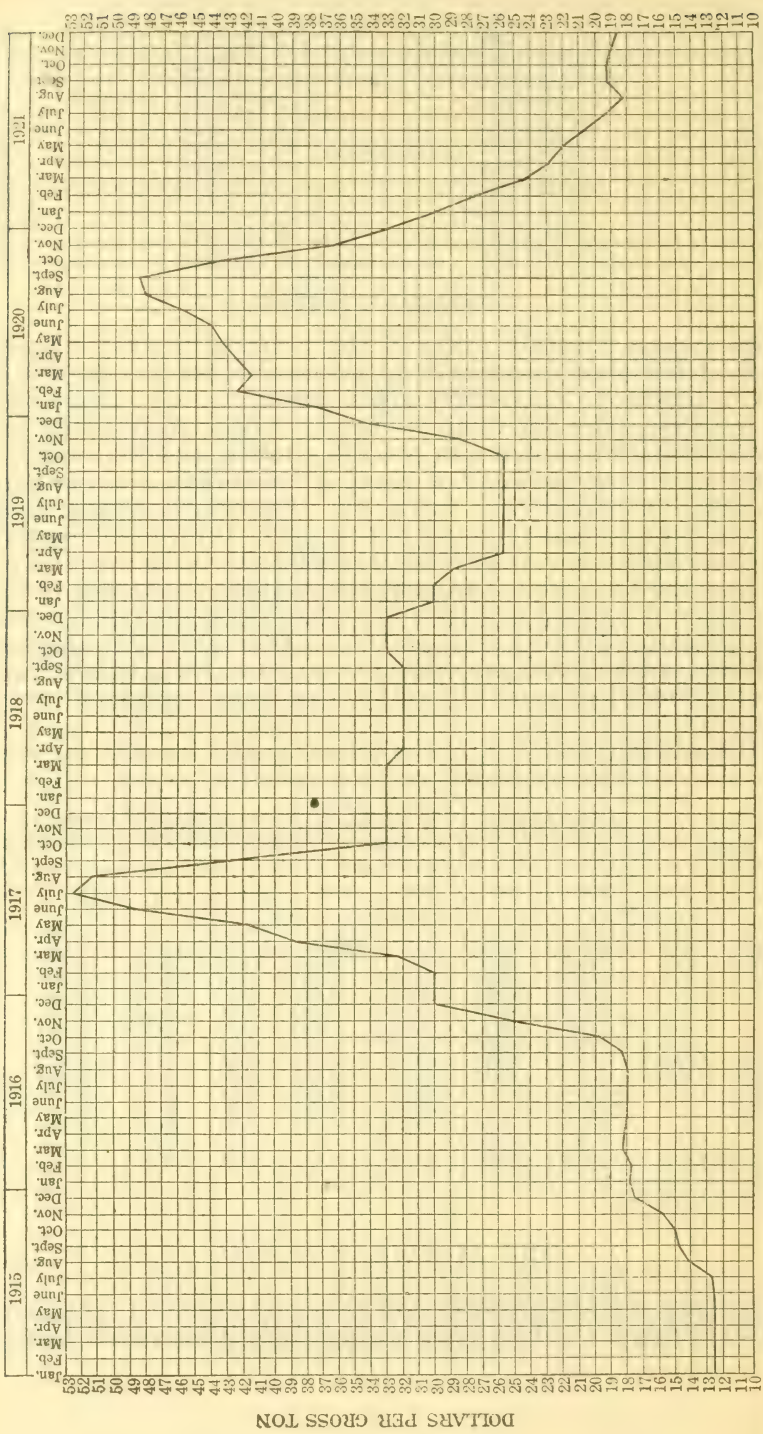

FIGURE 13.—Curve showing commercial quotations of basic pig iron at blast furnaces in Mahoning and Shenango valleys, Ohio and western Pennsylvania, 1915–1921, by months.

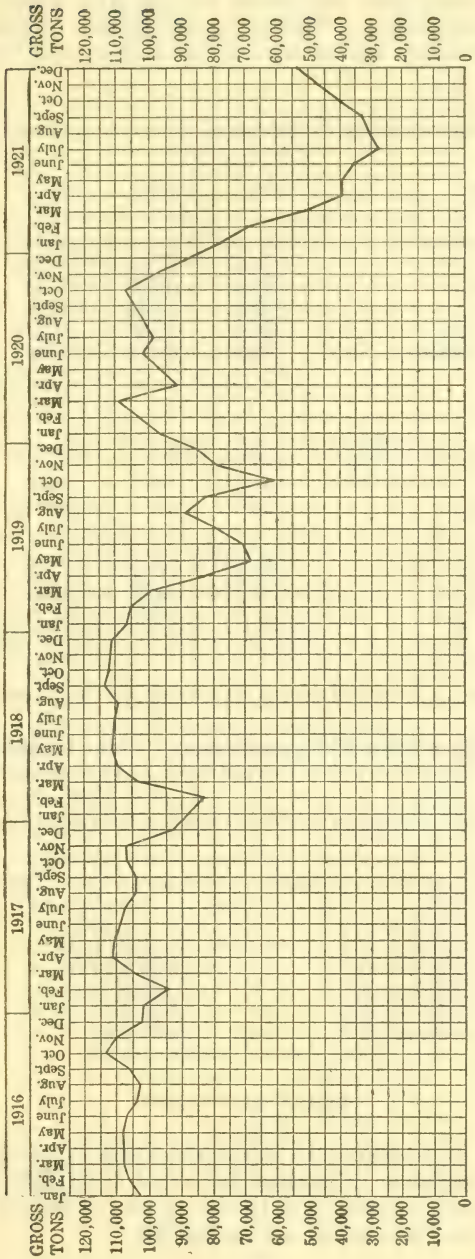

FIGURE 14.—Curve showing daily average production of coke and anthracite pig iron in the United States, by months, 1916–1921.

PRODUCTION BY GRADES AND BY FUEL USED.

The statistics of production of pig iron by grades and by fuel used for 1917–1921 have been published by the American Iron and Steel Institute as given below. These figures include ferroalloys. Metals made with electricity and with coke and electricity are included in coke pig iron.

Pig iron manufactured in the United States, 1917–1921, by grades, in gross tons.

Grade.	1917	1918	1919	1920	1921
Bessemer and low phosphorus	13,714,732	13,024,966	9,975,934	12,062,084	5,595,215
Basic	17,671,662	18,646,174	14,494,131	16,737,722	7,753,071
Forge	345,707	393,932	271,286	318,048	112,748
Foundry and ferrosilicon	5,328,258	5,145,260	4,916,758	5,957,782	2,568,136
Malleable	1,015,579	1,117,914	1,009,049	1,310,951	457,340
Spiegeleisen	192,985	283,853	84,246	111,449	56,423
Ferromanganese	260,125	333,027	185,357	295,447	103,755
White, mottled, direct castings, etc	92,168	109,518	78,603	132,504	41,438
	38,621,216	39,054,644	31,015,364	36,925,987	16,688,126

Pig iron manufactured in the United States, 1917–1921, by fuel used, in gross tons.

Fuel used.	1917	1918	1919	1920	1921
Bituminous, chiefly coke	37,863,643	38,422,175	30,549,930	36,300,024	16,579,653
Anthracite and coke	381,048	283,592	138,337	302,567	13,743
Charcoal	376,525	348,877	327,097	323,396	94,730
	38,621,216	39,054,644	31,015,364	36,925,987	16,688,126

TOTAL DOMESTIC PRODUCTION OF PIG IRON.

The next table shows the production in the United States of pig iron, including the commoner ferroalloys, as far as has been recorded.

Pig iron manufactured in the United States, 1810–1921, in gross tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1810–1860	10,542,548	1912	29,726,937	1919	31,015,364
1861–1870	11,366,963	1913	30,966,152	1920	36,925,987
1871–1880	24,055,278	1914	23,332,244	1921	16,688,126
1881–1890	56,902,041	1915	29,916,213		
1891–1900	98,124,754	1916	39,434,797		751,644,745
1901–1910	211,321,934	1917	38,621,216		
1911	23,649,547	1918	39,054,644		

BLAST FURNACES.

The number of furnaces in blast on June 30 and December 31 and the total number of stacks recorded for 1920 and 1921, not including any electric reduction furnaces, as published by the American Iron and Steel Institute, are as follows:

Blast furnaces in the United States, 1920 and 1921.

State.	In blast June 30, 1920.	Dec. 31, 1920.			In blast June 30, 1921.	Dec. 31, 1921.		
		In.	Out.	Total.		In.	Out.	Total.
Pennsylvania	117	73	90	163	27	46	115	161
Ohio	65	49	30	79	14	26	54	80
Illinois	19	16	9	25	6	9	17	26
Alabama	28	15	28	43	8	13	30	43
New York	21	16	11	27	3	10	17	27
Virginia	10	4	13	17	2		17	17
Tennessee	10	3	14	17		1	16	17
Colorado	3	3	2	5	2	1	4	5
Missouri	3	3		3	1		3	3
Oregon				1			1	1
Maryland	4	2	5	7	1	1	6	7
New Jersey	2	1	3	4	1	1	3	4
Wisconsin	4	3	5	8	1	1	6	7
Minnesota	2	2	1	3			3	3
Indiana	12	12	4	16	7	9	7	16
Michigan	11	10	3	13	2	4	9	13
West Virginia	4	3	2	5	1	2	3	5
Kentucky	5		7	7		1	6	7
Georgia			4	4			3	3
Texas			1	1			1	1
Mississippi			1	1			1	1
Connecticut	1		2	2			2	2
Massachusetts	1	1		1			1	1
	322	216	236	452	76	125	325	450

FOREIGN TRADE IN PIG IRON.

The quantity of pig iron and ferroalloys, principally ferromanganese and ferrosilicon, imported into the United States in 1921 decreased 76 per cent, compared with 1920. Separate statistics of imports of ferroalloys, given on page 593, indicate that the imports of pig iron alone (by difference) were 26,794 gross tons in 1921, compared with 107,547 tons in 1920. Belgium, Canada, and England furnished the largest quantity of these products in 1921.

Pig iron, including kentledge, ferromanganese, ferrosilicon, and spiegeleisen, imported into the United States, 1917–1921, in gross tons.

Country.	1917	1918	1919	1920	1921
North America:					
Canada	21,143	5,692	63,091	101,071	9,651
Costa Rica	18				
Cuba	83		30		
Mexico		120	5,994		
Newfoundland and Labrador					13
Panama	300				
South America: Brazil				466	
Europe:					
Belgium					12,004
France				5	127
Germany					3,508
Italy	20				
Sweden			51	105	1,088
Switzerland					10
United Kingdom: England	51,384	28,392	32,452	64,008	9,302
United Kingdom: Scotland	250		39	10,208	
Asia:					
British India		501		1,977	
China	3,503		8	3,555	4,610
Hongkong					250
Japan	85	6		3,851	2,002
Kwangtung				200	1,213
Oceania: Australia				498	258
	76,786	34,711	101,665	185,944	44,036

The pig iron exported from the United States in 1921 decreased nearly 87 per cent in quantity and 91 per cent in value, as compared with 1920. The largest quantities were shipped to Canada, England, Mexico, and Belgium.

Pig iron exported from the United States to foreign countries, 1917–1921, in gross tons.

Country.	1917	1918	1919	1920	1921
North America:					
Canada	153,745	122,325	33,751	56,100	16,271
Cuba	4,243	892	1,331	1,268	301
Mexico	920	297	1,103	2,348	1,534
Panama	1,816	881	483	624	662
Other countries	523	385	787	165	106
South America:					
Argentina	2,580	129	4,137	2,121	23
Brazil	1,483	72	979	951	84
Chile	8,888	4,345	6,611	2,545	471
Peru	578	694	1,253	280	729
Other countries	148	74	365	666	85
Europe:					
Austria-Hungary	.....	.....	417	.....	.....
Belgium	.....	.....	8,625	28,680	1,359
Denmark	1,836	.....	5,776	2,238	.....
France	65,618	8,181	683	451	77
Germany	.....	.....	.....	14,074	904
Italy	184,763	41,641	136,997	36,128	300
Netherlands	2,124	.....	5,220	20,384	.....
Norway	12,936	1,000	2,995	1,510	.....
Russia	6,017	.....	.....	.....	.....
Spain	5,891	.....	.....	.....	.....
Sweden	17,799	.....	2,844	8,207	300
Switzerland	1,404	.....	.....	2,649	.....
United Kingdom—					
England	138,196	66,197	34,741	11,127	4,194
Scotland	7,874	7,591	11,268	5,868	.....
Ireland	1,610	313	.....	.....	.....
Other countries	.....	.....	1,618	681	50
Asia:					
China	455	361	4,818	707	.....
Dutch East Indies	1,054	.....	1,620	1,651	50
Hongkong	246	1,164	1,081	151	.....
Japan	30,809	11,986	49,734	13,448	320
Other countries	724	.....	174	239	271
Africa	7	16	22	.....	.....
Oceania:					
Australia	257	30	259	485	.....
New Zealand	760	.....	716	270	.....
Philippine Islands	916	995	853	787	216
Other countries	.....	6	.....	25	.....
	656,220	269,575	321,261	216,828	28,307
Value	$24,037,051	$11,576,721	$12,313,183	$10,074,377	$933,093

PRODUCTION BY COUNTRIES.[11]

Pig iron produced in 1913 and 1917–1921, by countries, in metric tons.

Country.	1913	1917	1918	1919	1920	1921	Source of data.[a]
Australia	47,310	150,801	212,612	257,828	349,521	358,020	1913–1921, 1.
Austria	(b)	2,032,000	(c)	61,880	99,766	239,000	1917, 2; 1919–20, 3; 1921, 2.
Austria-Hungary	2,380,864	(c)	(c)	(d)	(d)	(d)	1913, 4.
Belgium	2,484,690	7,990	.....	250,570	1,116,400	876,390	1913–1920, 5; 1921, 6.
Canada	1,024,176	1,061,836	1,084,580	832,592	989,185	539,186	1913–1921, 7.
China	(c)	144,815	(c)	163,911	185,389	(c)	1917, 4; 1919–20, 8.
Czechoslovakia	(b)	(b)	(b)	(b)	650,000	437,000	1920–21, 2.
France	5,207,197	1,408,283	1,292,958	e 2,447,295	e 3,433,791	e 3,251,000	1913–1918, 9; 1919, 8; 1920, 10; 1921, 2.
Germany	e 19,309,172	e 13,142,247	f 11,758,967	5,604,408	7,620,000	8,636,000	1913–1918, 4; 1919, 6; 1920–21, 2.
Hungary	(b)	(b)	(b)	(b)	30,000	51,000	1920–21, 2.
India g	(c)	254,407	285,817	360,037	316,252	373,892	1917–1921, 11.
Italy	426,755	471,188	313,576	239,710	88,072	60,400	1913–1921, 12.
Japan	h 240,288	122,782	180,930	209,005	168,729	(c)	1913, 13; 1917–18, 14; 1919–20, 15.
Luxemburg	(i)	(i)	(i)	610,000	696,000	975,000	1919–1921, 2.
Norway	346	6,295	9,007	2,032	2,852	(c)	1913–1920, 21.
Philippine Islands	227	66	70	67	87	(c)	1913–1920, 15a.
Poland	(j)	(j)	(j)	15,214	42,221	254,000	1919–20, 8; 1921, 2.
Russia	4,868,140	3,215,000	(c)	(c)	15,000	61,000	1913, 16; 1917, 17; 1920–21, 2.
Spain	424,774	357,699	386,550	294,167	251,412	178,000	1913–1920, 18; 1921, 2.
Sweden k	736,330	838,948	767,922	495,033	474,813	308,600	1913–1920, 17; 1921, 13.
United Kingdom	10,424,993	9,487,514	9,253,558	7,536,450	8,163,674	2,743,000	1913–1920, 19; 1921, 2.
United States	31,461,610	39,239,155	39,679,518	31,513,161	37,518,649	16,955,970	1913–1921, 20.

[a] 1, Australian Metal Exchange; 2, Iron Trade Review, Jan. 5, 1922, p. 23; 3, Staatsamte für Handel und Gewerbe Industrie und Bauten; 4, National Federation of Iron and Steel Manufacturers (London); 5, Statistique des industries extractives et métallurgiques; 6, Statistische Reichsamt; 7, Canada Dept. Mines, Mines Branch; 8, official preliminary; 9, Statistique de l'industrie minérale; 10, consular report; 11, Records Geol. Survey India; 12, Rivista del servizio minerario; 13, Bur. Foreign and Domestic Commerce; 14, Financial and Economic Annual; 15, Mining industry of Japan; 15a, Mineral resources of the Philippines; 16, General review of the principal branches of the mining and metallurgical industries (Russia); 17, Bergshantering Sveriges officiella Statistik; 18, Estadística minera de España; 19, Mines and Quarries (London); 20, American Iron and Steel Institute; 21, Bergverksdrift Offisielle Statistikk.

[b] Included under Austria-Hungary.
[c] Figures not available.
[d] See under countries of former Austria-Hungary.
[e] Includes Lorraine.
[f] Excludes Lorraine, Saar district, and Luxemburg for November and December.
[g] Includes cast-iron castings.
[h] Financial and Economic Annual of Japan reports 56,675 tons.
[i] Included under Germany.
[j] Included under Russia.
[k] Includes small quantity of sponge iron 1913–1919.

[11] For additional data see pp. 513–564.

FERROALLOYS.

SHIPMENTS, VALUE, AND PRICE.

The statistics of output of ferroalloys in the United States were separated from those of pig iron in these reports in order to arrive at more nearly accurate values for these commodities. Although the quantity of ferroalloys is small compared with the total shipments of pig iron, the price per ton is so much greater as to unduly increase the apparent average price of the pig iron if included with it.

The shipments of ferroalloys of all classes in 1921, according to reports of all producers, decreased 59 per cent in quantity and 72 per cent in value, as compared with 1920. The ferrovanadium, ferromolybdenum, ferromanganese, spiegeleisen, ferrotungsten, ferrochromium, and ferrotitanium were made in part or wholly from ore imported from Africa, Bolivia, Brazil, British Columbia, Chile, China, Costa Rica, Cuba, India, Japan, Mexico, New Caledonia, Peru. Porto Rico, Russia, and Turkey.

Ferroalloys of domestic manufacture shipped, 1920 and 1921.

Variety of alloy.	1920		1921	
	Gross tons.	Value.	Gross tons.	Value.
Ferromanganese [a]	276,594	$41,840,690	111,374	$13,654,800
Spiegeleisen	103,672	5,289,049	[b] 69,230	[b] 2,838,692
Ferrosilicon (7 per cent or more silicon)	193,580	11,634,650	55,099	2,548,827
Ferromolybdenum	21	47,873	19	43,866
Ferrotungsten	1,084	1,623,710	195	193,914
Other varieties [c]	37,857	17,083,395	12,710	2,417,686
	612,808	77,519,367	248,627	21,697,785

[a] Includes a small quantity of silico-manganese.
[b] Includes a small quantity of silico-spiegel.
[c] 1920: Ferrocerium, ferrochromium, ferrophosphorus, ferrotantalum-columbium, ferrotitanium, ferrouranium, ferrovanadium, and ferrozirconium; 1921: Ferrocarbide, ferrocerium, ferrochromium, ferrophosphorus, ferrotantalum-columbium, ferrotitanium, ferrovanadium, ferrozirconium, and zirconium-ferrosilicon.

In 1921 ferromanganese was reported made at 12 localities in the United States, spiegeleisen at 6, ferrosilicon at 12, ferrophosphorus at 2, ferrochromium at 6, ferromolybdenum at 2, ferrotitanium at 2, ferrotungsten at 4, ferrotantalum-columbium at 1, ferrocerium at 1, ferrozirconium at 2, zirconium-ferrosilicon at 1, ferrocarbide at 1, and ferrovanadium at 7. In many localities, of course, several alloys were made at the same plant. In all there were reported 36 localities at which ferroalloys were made in 1921, compared with 51 in 1920.

The following records of average contract prices of ferromanganese and of spiegeleisen by months for the last four years show a wide range. The ferromanganese prices are prices quoted for material "delivered at Pittsburgh"; those of spiegeleisen are prices at producers' furnaces.

Quoted prices per ton of ferromanganese and spiegeleisen, 1918–1921.[a]

Month.	Ferromanganese.				Spiegeleisen.			
	1918	1919	1920	1921	1918	1919	1920	1921
January	$250.00	[b] $212.50	$146.00	$101.00	$59.00	[c] $67.50	$46.60	$46.25
February	250.00	165.00	160.00	96.85	59.00	[c] 52.50	57.60	37.75
March	250.00	134.00	172.00	89.00	65.50	[c] 42.50	60.40	34.20
April	250.00	113.75	200.00	87.50	[c] 70.00	[c] 34.50	66.85	32.00
May	[b] 250.00	110.00	200.00	83.00	[c] 71.00	[c] 31.35	75.00	31.75
June	[b] 250.00	111.75	198.00	76.50	[c] 75.00	[c] 27.50	75.00	29.60
July	[b] 250.00	111.00	190.00	75.00	[c] 75.00	34.00	75.00	27.50
August	[b] 250.00	110.00	193.75	70.75	[c] 75.00	34.00	79.35	26.20
September	[b] 250.00	105.00	172.40	64.75	[c] 75.00	34.00	82.00	25.25
October	[b] 250.00	110.00	156.40	61.65	[c] 75.00	34.00	80.00	24.85
November	[b] 250.00	110.00	153.00	60.00	[c] 75.00	34.00	74.35	25.00
December	[b] 236.00	121.00	120.00	60.00	[c] 72.50	39.00	64.40	25.00

[a] Iron Trade Review.
[b] Prices from May, 1918, to January, 1919, inclusive, based on 70 per cent ferromanganese; all other prices based on 80 per cent.
[c] Prices from April, 1918, to June, 1919, inclusive, based on 16 per cent spiegeleisen; all other prices based on 20 per cent.

IMPORTS AND EXPORTS.

The imports of ferromanganese were valued at $97.88 a ton in 1921, as compared with $131.22 in 1920. The imports of spiegeleisen were valued at $34.11 a ton in 1921, as compared with $53.10 in 1920. The imports of the alloys of the rarer metals are not all reported separately. For instance, the imports of ferrochromium, ferromolybdenum, and ferrotungsten are included with those of their respective metals.

Ferroalloys imported for consumption in the United States, 1919–1921.

Variety of alloy.	1919		1920		1921	
	Gross tons.	Value.	Gross tons.	Value.	Gross tons.	Value.
Chrome or chromium and ferrochromium	414	$100,404	1,751	$428,619	452	$106,669
Ferrophosphorus	176	13,388	6	780	5	132
Ferrosilicon	10,445	629,362	13,909	719,446	7,858	388,420
Molybdenum and ferromolybdenum	46	40,759	.....	.....	(a)	349
Titanium and ferrotitanium	5	3,317	1	713	2	1,299
Tungsten and ferrotungsten	177	287,981	892	1,180,829	226	180,371
Ferrovanadium	5	24,923	4	14,331	.....	.....
Ferromanganese	33,022	4,283,541	59,254	7,775,278	9,077	888,419
Spiegeleisen	27	1,018	5,234	277,900	307	10,472
	44,317	5,384,693	81,051	10,397,896	17,927	1,576,131

[a] 345 pounds.

Ferromanganese and ferrosilicon imported into the United States, 1919–1921, by countries.

[General imports.]

Country.	Alloy.	1919		1920		1921	
		Gross tons.	Value.	Gross tons.	Value.	Gross tons.	Value.
Canada	Ferromanganese	551	$59,146	203	$16,106	16	$2,059
	Ferrosilicon	10,445	629,362	13,885	715,449	7,409	363,702
England	Ferromanganese	32,402	4,215,939	56,128	7,242,252	8,802	873,198
	Ferrosilicon			19	3,833		
Scotland	Ferromanganese	39	6,484	1	349		
Japan	do			480	81,455		
Cuba	do	30	1,972				
France	Ferrosilicon			5	164	77	7,670
British India	Ferromanganese			1,977	336,908		
Brazil	do			465	98,208		
Germany	Ferromanganese					235	12,057
	Ferrosilicon					107	3,353
Sweden	Ferromanganese					24	1,105
	Ferrosilicon					255	12,029
Switzerland	do					10	1,666

Ferroalloys exported from the United States, 1919–1921.

Variety of alloy.	1919		1920		1921	
	Gross tons.	Value.	Gross tons.	Value.	Gross tons.	Value.
Ferromanganese	2,999	$445,840	3,454	$642,570	690	$100,474
Ferrosilicon	1,544	145,310	632	41,057	368	20,204
Tungsten and ferrotungsten	17	113,276	2	5,913		
Ferrovanadium	29	95,560	173	705,385	98	424,886

STEEL.

PRODUCTION.

The following tables showing the production of steel were compiled by the American Iron and Steel Institute. No data whatever are available on the value of the output of crude steel at the mills, but the weekly issues and annual statistical reviews of the Iron Age give market quotations of prices of steel billets and some of the leading forms of finished steel. The price of Bessemer steel billets at Pittsburgh during 1921 ranged from $29 to $43.50 a gross ton; in 1920 it ranged from $43.50 to $62.50. Tank plates ranged from 1.50 to 2.65 cents a pound in 1921 and from 2.65 to 3.75 cents in 1920. Steel beams at Pittsburgh ranged from 1.50 to 2.45 cents a pound in 1921 and from 2.45 to 3.25 cents in 1920.

Bessemer steel ingots and castings manufactured in the United States, 1917–1921, in gross tons.

State.	1917	1918	1919	1920	1921
Ohio	4,256,337	3,920,442	3,073,941	3,662,718	1,581,610
Pennsylvania	3,537,094	3,281,941	2,851,402	3,279,023	1,665,456
Illinois	1,763,052	1,229,568	906,324	1,243,837	532,539
Other States	923,477	944,285	439,895	697,509	236,333
	10,479,960	9,376,236	7,271,562	8,883,087	4,015,938

Open-hearth steel ingots and castings manufactured in the United States, 1917–1921, in gross tons.

State.	1917	1918	1919	1920	1921
New England States	332,597	329,630	286,826	290,967	102,642
New York and New Jersey	2,110,846	2,245,239	1,296,005	2,010,895	634,290
Pennsylvania	16,284,102	15,574,101	12,692,112	14,184,477	6,408,043
Ohio	6,074,857	6,729,955	5,112,616	6,341,016	3,108,332
Indiana	3,722,931	3,910,899	3,122,486	3,785,056	2,308,414
Illinois	1,966,296	2,283,991	1,664,993	2,302,776	1,093,268
Other States	3,657,264	3,385,576	2,773,656	3,756,708	1,934,813
	34,148,893	34,459,391	26,948,694	32,671,895	15,589,802

According to these tables there were decreases of 55 per cent in the production of Bessemer steel and of 52 per cent in open-hearth steel in 1921 compared with 1920. In the total production of steel there was a decrease of 53 per cent. Of the total output in 1921 nearly 79 per cent was represented by open-hearth steel, 20 per cent by Bessemer steel, and 1 per cent by all other classes of steel.

Of the total output of open-hearth steel, 15,082,564 gross tons were made by the basic process and 507,238 tons by the acid process, compared with 31,375,723 tons of basic and 1,296,172 tons of acid steel in 1920.

The production of steel by the electric process in 1921 showed a decrease of 66 per cent as compared with 1920.

Steel electrically manufactured in the United States, 1909 to 1921, in gross tons.

Year.	Ingots.	Castings.	Total.	Year.	Ingots.	Castings.	Total.
1909	13,456	306	13,762	1916	126,048	42,870	168,918
1910	50,821	1,320	52,141	1917	239,632	64,911	304,543
1911	27,227	1,878	29,105	1918	403,068	108,296	511,364
1912	14,147	4,162	18,309	1919	272,942	111,510	384,452
1913	20,973	9,207	30,180	1920	346,956	155,196	502,152
1914	15,458	8,551	24,009	1921	84,404	85,095	169,499
1915	46,348	23,064	69,412				

In the total production of electric steel in 1921 are included 62,618 tons of alloy-steel ingots and castings which were alloyed with nickel, vanadium, tungsten, chromium, molybdenum, and other metals (53,162 tons of ingots and 9,456 tons of castings), compared with 242,437 tons (233,862 tons of ingots and 8,575 tons of castings) so alloyed in 1920.

On December 31, 1921, the number of completed plants equipped for the manufacture of steel by the electric process was 198, as compared with 192 plants at the end of 1920. On January 1, 1921, it was reported that there were 356 electric furnaces of all types in the United States and 43 in Canada, and at the end of the year these totals had increased to 388 in the United States and 50 in Canada. The total number of furnaces in the world at the beginning and end of 1921 was estimated at 961 and 1,000, respectively, as compared with 140 in 1913.[12]

[12] Cone, E. F., The status of the electric steel industry: Iron Age, Jan. 5, 1922, pp. 85–88.

Steel produced in the United States, 1810–1921, in gross tons.

Year.	Bessemer.	Open-hearth.	Crucible.	Other steel.	Total.
1810–1870	58,482	2,232	146,370		207,084
1871	40,179	1,785	31,250		73,214
1872–1880	4,293,896	245,035	349,730	76,009	4,964,670
1881–1890	21,596,699	2,387,925	703,489	37,044	24,725,157
1891–1900	49,387,341	15,392,764	762,446	35,820	65,578,371
1901–1910	94,048,698	92,418,814	1,051,379	154,683	187,673,574
1911	7,947,854	15,598,650	97,653	31,949	23,676,106
1912	10,327,901	20,780,723	121,517	21,162	31,251,303
1913	9,545,706	21,599,931	121,226	34,011	31,300,874
1914	6,220,846	17,174,684	89,869	27,631	23,513,030
1915	8,287,213	23,679,102	113,782	70,939	32,151,036
1916	11,059,039	31,415,427	129,692	169,522	42,773,680
1917	10,479,960	34,148,893	126,716	305,038	45,060,607
1918	9,376,236	34,459,391	115,112	511,693	44,462,432
1919	7,271,562	26,948,694	63,572	387,404	34,671,232
1920	8,883,087	32,671,895	72,265	505,687	42,132,934
1921	4,015,938	15,589,802	7,613	170,444	19,783,797

FOREIGN TRADE IN STEEL.

The exports (so far as recorded) of iron and steel decreased 53 per cent in quantity and 51 per cent in total value in 1921, as compared with 1920.

Iron and steel imported into the United States, 1919–1921.

Article.	1919		1920		1921	
	Gross tons.	Value.	Gross tons.	Value.	Gross tons.	Value.
Bar iron	1,940	$220,863	4,987	$677,182	1,913	$203,486
Rails for railway	17,008	651,830	45,684	1,922,409	22,048	847,122
Scrap iron and steel	177,293	3,249,322	140,645	2,915,589	41,469	479,800
Sheets and plates	1,096	455,559	1,792	589,199	1,976	301,423
Steel ingots, blooms, blanks, and billets	8,230	440,470	9,299	562,545	5,678	162,265
Steel bars, mill shafting, castings, etc.	5,271	612,350	10,394	1,392,667	3,036	453,289
Steel ingots, blooms, slabs, etc., made by crucible, electric, or cementation process	2,768	2,795,925	4,540	2,937,388	1,310	674,850
Tin and terne plates	242	66,944	400	130,143	455	122,880
Wire and articles made from wire	.....	463,054	.....	1,440,813	.....	1,259,811
Wire rods	341	63,572	5,488	746,953	917	115,942
All other manufactures—free	.....	564,174	.....	2,141,874	.....	231,526
All other manufactures—dutiable	.....	3,834,741	.....	7,624,326	.....	6,201,847
Grand total	.....	13,418,804	.....	23,081,088	.....	11,054,241

Iron and steel exported from the United States, 1919–1921.

Article.	1919		1920		1921	
	Gross tons.	Value.	Gross tons.	Value.	Gross tons.	Value.
Axes	.....	$1,613,862	.....	$1,478,935	.....	$1,325,374
Bar iron	60,547	5,634,398	46,628	4,651,224	12,338	1,190,669
Bars or rods (of steel):						
Wire	118,010	8,374,716	116,775	8,884,854	18,953	1,112,234
All other	554,212	48,297,598	629,051	53,841,518	188,463	14,043,840
Billets, ingots, and blooms, not elsewhere specified	258,424	19,370,787	216,873	12,645,950	10,071	516,498
Bolts and nuts	39,743	7,769,893	38,944	7,274,411	24,230	4,884,596
Hammers and hatchets	.....	973,547	.....	1,303,185	.....	651,341
Hoops and bands	50,836	6,875,586	53,449	6,445,155	22,274	2,013,798
Horseshoes	3,385	539,452	1,834	260,583	615	109,444
Nails:						
Cut	2,921	393,284	3,858	573,990	1,094	133,629
Wire	89,779	10,744,696	93,179	11,880,398	28,109	3,192,054
All other, including tacks	16,234	4,638,093	12,435	3,068,120	4,691	1,178,064
Pipes and fittings:						
Cast iron	39,455	5,177,752	68,417	9,753,446	48,645	7,265,747
Wrought iron	236,080	35,229,750	284,771	43,774,296	345,376	48,953,189
Radiators and cast-iron house-heating boilers	4,656	779,259	7,336	1,337,032	3,408	575,427
Rails for railways, of steel	652,443	38,986,855	594,628	36,193,689	321,822	18,395,580
Railroad spikes	24,771	2,896,073	16,601	1,607,672	8,164	908,755
Railroad-track material, switches, frogs, fishplates, splices, bars, etc	.....	9,280,725	.....	7,570,236	.....	6,461,731
Saws	.....	4,851,791	.....	4,455,639	.....	2,358,243
Scrap and old, fit only for manufacture	27,275	717,325	219,250	6,411,534	37,592	580,023
Sheet and plates:						
Galvanized	101,637	15,223,289	108,368	16,727,590	56,085	7,754,343
Iron	39,892	4,837,547	32,157	4,036,239	12,414	1,578,055
Shovels and spades	.....	1,398,101	.....	1,294,291	.....	561,432
Steel:						
Plates	710,013	56,701,651	920,059	72,995,717	335,868	23,285,080
Sheets	177,466	21,214,529	169,244	21,199,524	193,433	18,732,662
Structural iron and steel	360,787	28,956,816	493,633	38,384,690	297,022	26,824,258
Tin and terne plates	204,521	36,997,634	226,410	40,545,291	107,714	17,415,152
Wire:						
Barbed	101,451	11,534,297	129,710	16,056,346	29,976	3,558,691
All other	190,212	24,641,881	190,969	25,371,776	69,336	8,726,123
All other tools	.....	14,382,767	.....	16,945,325	.....	8,354,163
Grand total	.....	429,033,954	.....	476,968,656	.....	232,640,695

GOLD, SILVER, COPPER, AND LEAD IN ALASKA.[1]

(MINES REPORT.)

By Alfred H. Brooks.

PRODUCTION.

The following table gives an estimate of the total production of gold, silver, copper, and lead in Alaska to the end of 1921:

Gold, silver, copper, and lead produced in Alaska, 1880–1921.

Year.	Gold.		Silver.		Copper.		Lead.	
	Fine ounces.	Value.	Fine ounces.	Commercial value.	Pounds.	Value.	Short tons.	Value.
1880–1915	12,619,051	$260,858,943	4,923,198	$2,821,911	219,913,375	$34,919,581	1,261	$109,604
1916	834,068	17,241,713	1,379,171	907,495	119,854,839	29,484,291	820	113,160
1917	709,049	14,657,353	1,239,150	1,021,060	88,793,400	24,240,598	852	146,584
1918	458,641	9,480,952	847,789	847,789	69,224,951	17,098,563	564	80,088
1919	455,984	9,426,032	629,708	705,273	47,220,771	8,783,063	687	72,822
1920	404,683	8,365,560	953,546	1,039,364	70,435,363	12,960,106	875	140,000
1921	390,558	8,073,540	761,085	761,085	57,011,597	7,354,496	759	68,279

The mining industry of Alaska continued in a serious depression in 1921, the value of the total mineral output decreasing more than $6,000,000. The decrease was chiefly in copper. The output of the gold placers increased slightly, but that of the gold lode mines has fallen off, chiefly because of the closing of the Perseverance mine.

GOLD AND SILVER.

The subjoined table gives an estimate, based on the best available data, of the gold and silver produced in Alaska from different sources since mining began in 1880. About $65,900,000 worth of gold, or about one-fifth of the total estimated output, was produced before 1905, and there is but scant information as to its source. For the period since that time fairly complete statistical returns are available, and it is probable that the figures presented in the following table are sufficiently accurate to be valuable. The figures given for the silver recovered from placer gold and from siliceous ores are probably less accurate than those for the gold. Copper mining did not begin in Alaska until 1901, and the figures for gold and silver derived from this industry, as now presented, are therefore a close approximation to the actual output.

[1] The data on mining conditions and production here given are abstracted from a paper published in U. S. Geol. Survey Bulletin 739. The author was assisted in the statistical work by T. R. Burch. The original paper and the papers that accompany it treat the subject at greater length than is desired here, and they should be consulted by those who require the more detailed information.

Gold and silver produced in Alaska from different sources, 1880–1921.

Source.	Gold.		Silver.	
	Fine ounces.	Value.	Fine ounces.	Value.
Siliceous ores [a]	4,847,738	$100,211,663	1,868,163	$1,514,879
Copper ores	86,128	1,780,438	7,043,148	5,502,063
Placers	10,938,168	226,111,992	1,822,336	1,087,035
	15,872,034	328,104,093	10,733,647	8,103,977

[a] Including small quantities of lead ore.

Gold and silver produced in Alaska, 1921, by sources.

Source.	Ore.	Gold.		Silver.	
		Fine ounces.	Value.	Fine ounces.	Value.
Siliceous ores	short tons	2,894,813	184,707	$3,818,226	99,515	$99,515
Copper ores	do	477,121	1,329	27,471	545,229	545,229
Lead ores	do	727	89	1,843	93,776	93,776
Placers	cubic yards of gravel	4,812,721	204,433	4,226,000	22,565	22,565
			390,558	8,073,540	761,085	761,085

LODE MINING.

Nineteen gold and silver lode mines and thirteen prospects [2] were operated in 1921 and produced gold worth $3,820,069. In 1920 seventeen gold and silver lode mines and five prospects were operated and produced gold worth $4,473,687. The decrease was entirely in the output from the gold mines of southeastern Alaska, as the output from all the other districts increased slightly.

Gold and silver produced from gold and silver lode mines and prospects in Alaska, 1921, by districts.

District.	Mines operated.	Ore mined (short tons).	Gold.		Silver.		Average value per ton of ore in gold and silver.
			Fine ounces.	Value.	Fine ounces.	Value.	
Southeastern Alaska	[a] 6	2,889,752	176,158.62	$3,641,522	102,070	$102,070	$1.29
Willow Creek	[b] 5	3,591	5,721.50	118,273	1,029	1,029	33.22
Fairbanks district	[c] 3	944	1,858.27	38,414	279	279	40.99
Other districts [d]	5	1,253	1,057.53	21,860	89,913	89,913	89.20
	19	2,895,540	184,795.92	3,820,069	193,291	193,291	1.39

[a] Also 4 prospects.
[b] Also 2 prospects.
[c] Also 1 prospect.
[d] Includes output of 3 prospects on Prince William Sound, 2 mines on Kenai Peninsula, 1 prospect in the Kuskokwim region, 1 mine and 1 prospect in the Kantishna district, 1 mine and 1 prospect in the Ruby district, 1 mine in Seward Peninsula, and some ore of unknown origin.

[2] Lode properties the value of whose total metallic output is less than $1,000 each are here classed as prospects. These include some mines on which considerable development work has been done but which have not yet been put on a regular productive basis.

PLACER MINING.

During 42 years of mining Alaska has produced gold to the value of $328,100,000, and of this amount $226,112,000 is to be credited to her placer mines. In 1921 there was a marked improvement in the placer-mining industry, compared with 1920. This was expressed not only by an increase of about 9 per cent in the gold output, but also in the number of large placer-mining projects that were under way. This revival of Alaska placer mining is due to a general lowering of costs in the more accessible districts, though these are still very high.

Gold and silver produced from placer mines in Alaska, 1921, by regions.

Region.	Gold.		Silver.		Gravel mined (cubic yards).	Recovery per cubic yard.
	Fine ounces.	Value.	Fine ounces.	Value.		
Southeastern and southwestern Alaska	193.50	$4,000	33	$33	2,283	$1.75
Copper River region	10,642.50	220,000	1,110	1,110	341,183	.64
Cook Inlet and Susitna region	7,981.87	165,000	1,164	1,164	347,423	.47
Yukon Basin	89,977.50	1,860,000	11,952	11,952	1,574,546	1.18
Kuskokwim region	25,155.00	520,000	2,959	2,959	195,529	2.66
Seward Peninsula	70,143.75	1,450,000	5,307	5,307	2,347,418	.62
Kobuk region	338.63	7,000	40	40	4,339	1.61
	204,432.75	4,226,000	22,565	22,565	4,812,721	.88

The following table is based in part on returns made by operators of placer mines and in part on known facts or assumptions concerning the richness of the gravels in the several districts. Although the table is thus in part an estimate it is probably nearly correct.

Gravel sluiced in Alaskan placer mines and value of gold recovered, 1916–1921.

Year.	Total quantity of gravel (cubic yards).	Value of gold recovered per cubic yard.	Year.	Total quantity of gravel (cubic yards).	Value of gold recovered per cubic yard.
1916	7,100,000	$1.57	1919	4,548,000	$1.10
1917	7,000,000	1.40	1920	3,439,900	1.13
1918	4,931,000	1.20	1921	4,812,700	.88

Gold produced by dredge mining in Alaska, 1916–1921, and comparison of recovery with that of other placers.

Year.	Number of dredges operated.	Gravel handled (cubic yards).	Value of gold output.	Percentage of placer gold produced by dredges.	Recovery per cubic yard.		
					Dredges.	Mines.	All placers.
1916	34	3,900,000	$2,679,000	24	$0.69	$2.64	$1.57
1917	36	3,700,000	2,500,000	26	.68	2.21	1.40
1918	28	2,490,000	1,425,000	24	.57	1.84	1.20
1919	28	1,760,000	1,360,000	27	.77	1.31	1.10
1920	22	1,633,861	1,129,932	29	.69	1.53	1.13
1921	24	2,799,519	1,582,520	37	.57	1.31	.88

The 24 dredges operated in 1921 employed 373 men. Two of these dredges were in the Fairbanks district, 2 in the Iditarod district, 1 in the Innoko district, 1 in the Mount McKinley (McGrath) district, 1 in the Circle district, 1 in the Yentna district, and 16 in Seward Peninsula. The average gold recovery of the 6 Yukon and Kuskokwim dredges was 90 cents per cubic yard, and that of the Seward Peninsula dredges was 39 cents per cubic yard. The inland dredges were operated from 90 to 145 days. The Seward Peninsula dredges were operated from 90 to 121 days, averaging about 100 days.

COPPER.

The total copper output of Alaska was 57,011,597 pounds, valued at $7,354,496, in 1921 and 70,435,363 pounds, valued at $12,960,106, in 1920. The output in 1921 was obtained from one mine in southeastern Alaska, three mines in Chitina Valley, one on Prince William Sound, and one in Ketchikan Valley. The copper ore treated amounted to 477,121 tons and contained, in addition to the copper, $27,471 in gold and 545,229 fine ounces of silver. The decrease in output is the result of curtailment of production at the four large Alaska copper mines—the Kennecott-Bonanza, Jumbo, and Mother Lode in the Chitina basin and the Beatson-Bonanza on Prince William Sound. It is in turn but a reflection of the world-wide depression in the copper-mining industry. The Rush & Brown mine, in the Ketchikan district, is the only other Alaska copper mine that was operated on a productive basis throughout the year. There was, however, a little copper output from half a dozen other localities in Alaska during 1921. Some alluvial copper was produced incidentally to gold-placer mining in the Nizina district.

The average copper content of the ore mined in 1921 was 5.8 per cent. The average yield for 1920 was 4.6 per cent.

Of the total copper ore mined in Alaska in 1921, 94 per cent, or 448,236 tons, was concentrated and yielded 47,571 tons of concentrates, which averaged 35 per cent of copper. Most of the copper concentrates and crude ore were shipped to the Tacoma smelter.

LEAD.

The lead produced in Alaska in 1921 amounted to 759 tons, valued at $68,279, as compared with 875 tons, valued at $140,000, in 1920. This lead came from the gold ores of the Juneau district and from galena ores mined for their high silver content, chiefly in the Kantishna and Ruby districts of the Yukon and the Fairhaven district of Seward Peninsula. A total of 727 tons of these silver-lead ores was shipped in 1921, and these yielded on the average 129 ounces of silver to the ton and 35 per cent of lead. Including the small content of gold and copper, the average value of these silver-lead ores was $164 a ton.

All this mining was limited to the extraction of rich ore shoots, for the cost of transportation has thus far prohibited the exploitation of ore of lesser metallic contents. The search for such valuable silver-lead deposits has brought additional evidence of the widespread occurrence of galena ores in Alaska. In the Kantishna district some evidence has also been found of the presence of larger ore bodies than have thus far been exploited.

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